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ABSTRACT

Environmental/ecological experiences, appropriate for elementary grades, are presented in this compilation. Designed as individual units of study, they consider components of the natural environment and in particular the local environment of Burke County, North Carolina. Units are titled: Burke County in a Nutshell, Our Culture, A Tour of the Burke County Water Treatment Plant, A Tour of the Morganton Sewage Treatment Plant, The Burke County Landfill, Linville Gorge--An Outdoor Teaching Laboratory, Air, Noise Pollution, and Solid Waste. They detail background information pertinent to the subject, educational objectives, suggested activities, procedures, glossary of terms, and additional resources. This work was prepared under an ESEA Title III contract. (BL)

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EDUCATIONAL EXPERIENCES PROGRAM

BURKE COUNTY IN A NUTSHELL

Environmental Ecological Education
Burke County Title III
Richard A. Peck, Director

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BURKE COUNTY IN A NUTSHELL

General Information

1. Burke County was formed in 1777 from Rowan County.
2. Burke County was named for Thomas Burke who was lawyer, doctor, and later governor of North Carolina.
3. Burke County contained parts of thirteen present counties as it extended to the Mississippi River.
4. The first courthouse was built in 1785. The present courthouse was built in 1833.
5. Three-fifths of Burke County is Piedmont (meaning lying at the base of mountains).
6. Burke County is 539 square miles.
7. The Catawba (which means catfish in Indian) River forms a ten-mile northern boundary.

Mountains

1. Highest mountain in Burke County is Gingercake, 4450 feet high.
2. Table Rock is 3909 feet high.
3. Hawksbill is 4035 feet high.
4. Long Arm is 4350 feet high.
5. Brown Mountain is 2600 feet high.
6. Grandfather Mountain is 5964 feet high but not in Burke County. It is the highest Blue Ridge peak in the area. Evidence of life has been found on the mountain (pottery) and dates back thousands of years. Andre' Michaux was the first to write about climbing Grandfather in 1794. The mountain is named for its profile of a grandfather face resting on a pillow and covered with a rock blanket. Three counties meet at its highest point. Sediment deposited 600-700 million years ago now make up the outer layers of Grandfather. Formation date of the mountain is unknown.
7. South Mountains on one side and Blue Ridge Mountains on the other form a corridor making up a large section of Burke County. The South Mountains average only about 2000 feet while the Blue Ridge Mountains average over 3000 feet.

8. The Smoky Mountains are part of the Blue Ridge Mountains.

9. The Blue Ridge Mountains formed the boundary between the Cherokees and white men in 1767.

10. Mount Mitchell is not in Burke County. It is the highest peak east of the Mississippi River at 6684 feet high. It was named for Dr. Elisha Mitchell, professor of chemistry, mineralogy, and geology at U.N.C. He died in 1857 while climbing on the mountain and was buried in Asheville for a year. People made a fuss and convinced the family he should be buried on top of the mountain. He was finally buried on top of the mountain one year after he died. Thomas Clingman had challenged Mitchell's claim that Mt. Mitchell was the highest peak and this is when Mitchell climbed and fell to his death in an attempt to confirm his claim.

Land

1. After the Revolutionary War, North Carolina could not afford to pay the soldiers so it gave away land in what is now Tennessee.

2. Linville Gorge is twelve miles long and drops 2000 feet from its start to Lake James. The Gorge was named for William Linville who, with his son, was scalped by Indians in 1766.

People

1. The first non-Indian people to settle in Burke County were Scotch Irish and Germans (Pennsylvania Dutch). Before they came Catawba and Cherokee Indians roamed this area.

2. Henry Weidner settled this area around 1742 and the Henry River is named for him.

3. Bishop Spangenburg explored area as far west as Linville Gorge hoping to establish a Moravian settlement. He traded with Indians who thought he was a Quaker in the area called Quaker Meadows.

4. A Waldensian colony purchased a large tract of land around what is now Valdese. Their farmlands in Europe were getting too populated so some moved to North Carolina in 1893.

5. Jonas Braswell froze to death around Linville Gorge and the place was called Jonas Ridge.

6. Anthony Drexel was director of the Southern Railway when a station was built and named Drexel.

7. The Connelly family owned land surrounding the famed mineral springs resort area.

8. Glen Alpine (meaning mountain valley) started around a knitting mill, hosiery mill, and lumber company.

9. Rutherford College was a private school (1853-1932) that had secondary and college level students.

10. John D. Rockefeller, Jr. donated the land around Linville Falls.

11. Nolichucky Jack was John Sevier who was governor of the state of Franklin. Franklin was the land in Tennessee that North Carolina had given to Revolutionary War soldiers. It broke away from North Carolina and Sevier was branded a rebel by the N. C. officials.

12. Hildebran was a lumber merchant who set up business in the eastern part of the county.

13. The McKinney family lived at the foot of Hawksbill Mt. One night when Mr. McKinney failed to return home a search was started for him. A search party saw a hand sticking from a pile of leaves and ran for more help. When they returned the hand was gone. Mr. McKinney's body was found later about a half mile away at Sitting Bear. No one ever determined who killed McKinney or why he was killed.

Dates

1752 -- Bishop Spangenburg explored Burke County area with intention of establishing Moravian colony. He got about as far as Grandfather Mt. before turning back. This was not as good an area as he had hoped.

1767 -- Boundary of Blue Ridge Mountains established between white men and Cherokees.

1777 -- Burke County formed with no western boundary other than Mississippi River.

1784 -- State of Franklin formed from northwest part of North Carolina.

1828 -- Gold discovered at Brindletown at foot of Pilot Mt. This started largest American gold strike before California. Gold mining spread into counties around Charlotte and eventually so much was being taken a mint was established in Charlotte in 1837. Gold in Burke County was discovered by a wandering prospector who stopped to have his shoes repaired. Of the one hundred or so places gold was found the average weekly take was $2000. The main rush lasted only about five years but mines still operated into the twentieth century. Total estimates for gold taken out of Burke County ranged from six to sixteen million dollars.

1916 -- The first flood began July 5 with the Catawba rising sixteen feet. July 13 was the date of an even bigger flood in Burke County.

1916 -- Construction of the dam at Lake James was begun. This was not as a result of the big flood because plans had been underway before the flood.

Suggested Resources

"Spotlight On Burke" by Elizabeth Kincaid and Fred Cranford

"The Waldenses of Burke County" by Fred B. Cranford

Carolina Room Files in Morganton Library

EDUCATIONAL EXPERIENCES PROGRAM

OUR CULTURE

Environmental Ecological Education
Burke County Title III
Richard A. Peck, Director

OUR CULTURE

Advertising and Products

Advertising is a form of propaganda. Every day the average American is bombarded with about 1600 ads through sight, sound, or both. Magazines, television, and radio are prime examples of media used in advertising. Visualize, if you will, the last advertisement you remember having or seeing. What major factors were used to sell the product? What implications were involved? What environment was in or suggested by the ad? Consider the following examples: Take a breath of springtime with our cigarette! A beautiful natural landscape forms the backdrop for a new car. Pepsi is for the young generation. You probably have bad breath unless you use this mouthwash.

How can toxic, obnoxious smoke come close to suggesting a spring day? Why are the smokers put in beauty of a stream, field, or woods? Do they try to present an aesthetically pleasant picture so you identify with it rather than the disgusting idea of smoking?

What are the reasons for showing new cars in the country or natural settings? Why not use a smoggy city as the backdrop? How does the automobile relate to the environment? Minerals are mined to produce it, energy is required to make and move it, obnoxious gases are given off during its use, hulks of old cars dot or blacken portions of our land, and yet these are never mentioned in the advertisement.

Many advertisements leave you with a false sense of security. Labels on throw away bottles and cans say: Do not litter, dispose of properly. Another example: Aluminum cans can be recycled. Do you dispose of non-returnables properly? Simply putting in a trash barrel moves the problem into the solid waste category. Perhaps aluminum cans can be recycled but generally they are not. Burying a can that can be recycled has no better effect than burying a can without that label.

Look at the following slides of products found on supermarket shelves. Consider the following features for each product. What resources went into its manufacture (minerals, energy)? What effect will it have on you when you use it? What will remain after the product is used (can, bottle, foil, paper)? Is the product necessary? What is the environmental impact of the product?

Suggested Activities:

Analyze printed commercials to determine answers to the previous questions: ie. people pictured as having a good time with a drink.

Bring in samples of products demonstrating environmentally good and bad buying habits.

Bury different kinds of trash (metal, glass, paper, food) and see what happened after a week, a month.

Research what products can be made from recycled paper, glass, metals, oil, wood.

What effects on the body result from alcohol, tobacco, caffein, drugs, smoke, smog?

This page was created by Mrs. Debbie Badgley, staff member at the Madison County Environmental Center.

AD - STUDY

1. Name of product: _____

2. Evaluate the environment in which the product is placed. Describe it.

_____

_____

_____

3. Explain how the environment pictured helps to sell the product.

_____

_____

_____

_____

4. What arguments are used to convince you to buy the product? What does it promise you?

_____

_____

_____

_____

_____

5. Which of your needs (physical, social or emotional) is the product going to fulfill?

_____

_____

6. What is the environmental impact of the manufactured product? In other words, how does it effect the environment? The environment might be your own - you.

_____

_____

_____

TIMES ARE A 'CHANGIN'

The world is changing rapidly and as a result problems have arisen. Consider the myriad of social ills confronting our society and then wonder where we will go from here.

ITEM: Today most things are changing so about the only constant is change. Products, heroes, packages, buildings, values -- all are instant successes which fade on the horizon. Remember convertible cars? How about Elvis Pressley or Roger Maris? Where are Ball canning jars now? Do you remember corner soda fountains which had malts and shakes? Penny loafers and saddle shoes came in and went out.

Most things in which we come in contact are temporary. Food is purchased in throw away containers. Clothes, if they last, go out of fashion in a couple years. Cars, while good for many miles, have built in obsolesence. Few people live and die in the same house or community where they were born. Products seldom last a "lifetime" so no affinity is developed. Neighbors change, houses are torn down, supermarkets replace small corner groceries, and the world moves on even if we are not ready. What can one hold to to maintain sanity? What can be used as a haven for regrouping one's thoughts and emotions?

ITEM: Speed is a life style. Cars, jets, telephone, television, and radio speed up everything. An event in China can be known the instant it happens by way of satellite. Life, too, is accelerated with more events, facts, and personalities crammed into a lifetime than ever before. No previous generation has had so much firsthand experience as the present. Visiting, buying, eating, and observing are taken for granted in a society where California and New York can be visited in a couple hours.

ITEM: Job skills and training are not necessarily good for a lifetime. The blacksmith who toiled all his life at his trade has been replaced by auto mechanics who must relearn their trade periodically to keep abreast of new models. Jobs are created and abolished at the whim of a top executive. Repairmen are often too expensive when compared to purchasing a new mass-produced item so the days of the shoe repairman, for example, may be numbered. Assembly line employees have little pride in what they make since all they do is twist ten bolts on a minor part. Pride and identification with a job well-done are traits of yesteryear.

ITEM: Products are easy to secure. Mass production and imports have lowered prices of many goods. Where costs are still high rental agencies have appeared. Houses, trailers, clothes, appliances, and cars are but a few familiar products one can rent. Add to this the complicating factor of easy credit and a person can then secure almost anything or go anywhere.

ITEM: Morals and mores are quick to change with mass communication. Obvious examples of the change are hair and clothing styles. The trademark of the current idol may be old-fashioned next year. Consider the range of alternatives open to people now. Food, clothes, homes, cars, religions, jobs, education, marital or living partners, family planning, and other factors making up a life style are now viable alternatives to anyone. Could it be we now have too many options from which to choose? Over-stimulation or too many alternatives could be a real concern to mental health, especially when decisions must be made quickly and without previous experience.

Times are changing with women becoming militant in demands for equal rights. Both sexes are fighting for more liberal views of sex from hetero and homosexual views. Questions shaking the very foundations of family organization have arisen. Is it wrong for the male to want to remain at home taking care of the children while the mother is happy being a breadwinner professional? Why should couples who do not wish to have children be considered weird?

Family units may be undergoing the first stages in a major change. Divorce is easy to attain and trial marriages may be the next step before the pact is formalized. If after a certain period both parties agree the final marriage occurs; if not the people go their separate ways. Abortion, artificial insemination, adoption, cultured babies, and gene manipulation are not far-out ideas for the future, there are here today! Such factors alter hereditary and environmental patterns. People now openly talk of abortion, the pill, and adoption whereas in the past such subjects were taboo. Who can give adequate attention to the following question? Why are certificates, licenses, skill tests, etc. required for jobs but nothing need be proven or demonstrated to be a parent?

Gene manipulation thrusts open a whole new list for consideration. To what extent will embryo genes be manipulated? Who shall determine what shall be done? Will a super-race be established. Will a work caste be created? Will cost enable anyone to participate? Will manipulation be required in instances of suspected disease or mutation? What new laws will result?

ITEM: Along with the changes mentioned above will have to come others, especially in education. If job training is no longer good for a lifetime people will have to return to school at various times for different reasons. Education may be geared more toward leisure than vocational aspects since each generation has faced shorter working hoursand more leisure time. Planned obsolescence of people (early retirement) has caused emotional and psychological difficulties for those not prepared for the shock. Perhaps education can somehow help by providing alternatives to people nearing retirement age. Presently college courses are offered preparing people for marriage, family relations, and death. If the future holds undreamed of ideas then perhaps the greatest contribution education can make is teaching people to be flexible. Consider the idea that no behavior, idea, or fact is true for all-time. Mannerisms, behavior, and thinking must periodically be discarded in favor of a whole new life style.

If these ideas do not sound like they relate to the environment, here are some things to ponder.

1. How should our lives, economy, or culture be measured? Is economic gain enough? population stability? income level? environmental impact? aesthetics? amount and type of leisure activity?

2. How can we manipulate technology instead of vice-versa? drugs? industry? priorities? products? necessities? competition vs. cooperation? life style? education? environmental clean-up and protection?

3. What population manipulation will we tolerate? growth? aging? birth control? gene control? interference in other countries?

4. What moral and mores changes will affect the environment? more people? more scientists? feeling of being superior to the total environment? (Read in the Bible Genesis 1:28) more personal independence? security of technology over spiritual help? selfish concerns vs. concerns of society?

5. What new laws will be needed? Which will be eliminated? How will human rights be affected? Is it within the domain of courts or governments to outlaw products or processes that affect the environment? If a car is banned or made pollution-free why not abolish smoking?

6. What products, activities, services, or time will be required or suggested to feed, protect, entertain, and maintain an increasing population?

7. Can we continue to tie up land and minerals by burying dead people? Should laws be passed limiting age of people? euthanasia? maintaining a mutant embryo?

EDUCATIONAL EXPERIENCES PROGRAM

A TOUR OF THE BURKL COUNTY WATER TREATMENT PLANT

By

Ernest Morgan

Environmental Ecological Education
Burke County Title III
Richard A. Peck, Director

OBJECTIVES

1. Students will observe the processes and list six steps in treating water from the Catawba River before the water is clean enough to drink.

2. Students will list at least two chemicals that are added to our drinking water.

Clean water is a basic need to most life forms. In this day of technology, most students are unaware of water quality and the strain that technology puts on natural water supplies. Most students seem to think that fresh, clean water comes from a never-ending supply located in outer space or some other far away place remote from earth. They also seem to have the idea that used dirty water such as water in feces and urine, is somehow transported through a pipe to an unlimited storage area far from their fresh water supply. You might call this the "pipe it in from space, pipe it out" concept. Such a concept needs to be changed. Students should realize that:

A. The water they use and see around them has been here since the formation of the earth. There is no new water.

B. Tap water in and around the centers of population comes from local streams and is treated before use.

C. The water that is used by people returns to the natural environment and is reprocessed and reused.

D. Burke County citizens are responsible for the condition of all water that originates within the boundaries of the county.

WHO SHOULD YOU CONTACT?

A fieldtrip to the Morganton water plant may be arranged easily. Call Mr. Carl Hennessee at the Filter Plant # 1 -- Telephone 437-3670, or City Hall -- 437-8863, extension 37.

A NOTE ON SAFETY AND DISCIPLINE

1. Be sure to caution students not to touch or tamer with any levers, switches, or buttons. One turned lever can create a problem that may take hours to correct and contaminate thousands of gallons of water.

2. Keep students together at all times.

3. When walking in the tank areas, walk between guard rails only and do not lean on guard rails.

4. Caution students to secure loose items like glasses or pens in shirt pockets. If they lean over to look at the water, loose objects may fall into the tank and are unretrievable.

5. Do not enter the chlorine room.

6. When around any pumps or moving machinery be very careful not to catch clothes in moving parts. BE CAREFUL.

GLOSSARY

For best results, familiarize yourself and your students with the following terms before the fieldtrip.

raw water - untreated water brought from a natural source such as the Catawba River

flocculate - particles of matter clumped together and suspended in solution. When large enough clumps form the heavy weight results in the material falling to the bottom of the tank (settling out).

particulate - small pieces of material found in solution

aluminum sulfate - chemical compound that attracts and holds particulates. The basic chemical notation for aluminum sulfate is $Al_2(SO_4)_3$. This is added to raw water.

settling tanks - tanks where particles from flocculated water settle to bottom

weir - walls over which water flows. Large particles are too heavy to pass over weirs and settle out.

sediment - particulate matter which settles out of solution

wash water - water pumped backwards through settling tanks to flush out collected sediment or particulates

chlorine gas - poisonous gas added to water in controlled amounts to kill bacteria and other living organisms

fluorine gas - a poisonous gas added to water in small amounts to protect human teeth from decay

sodium hydroxide - a chemical added to water to neutralize or offset acid consistency of water

watershed - area surrounding stream or lake which affords natural drainage of water into that stream

microbes - microscopic living organisms

algae bloom - water plants that multiply rapidly in bodies of water causing a green color or sometimes a scum. This occurs when phosphates or other plant food is in abundance in the water. When the algae die an offensive odor or taste results in the water.

phosphate - a chemical compound containing oxygen and phosphorus. This is a plant nutrient and is applied as fertilizer by farmers. Some of these phosphates run off the land into water supplies like ponds or streams. Phosphates are also found in washing detergents and these pass through sewage plants into bodies of water.

upstream - direction from which river is flowing

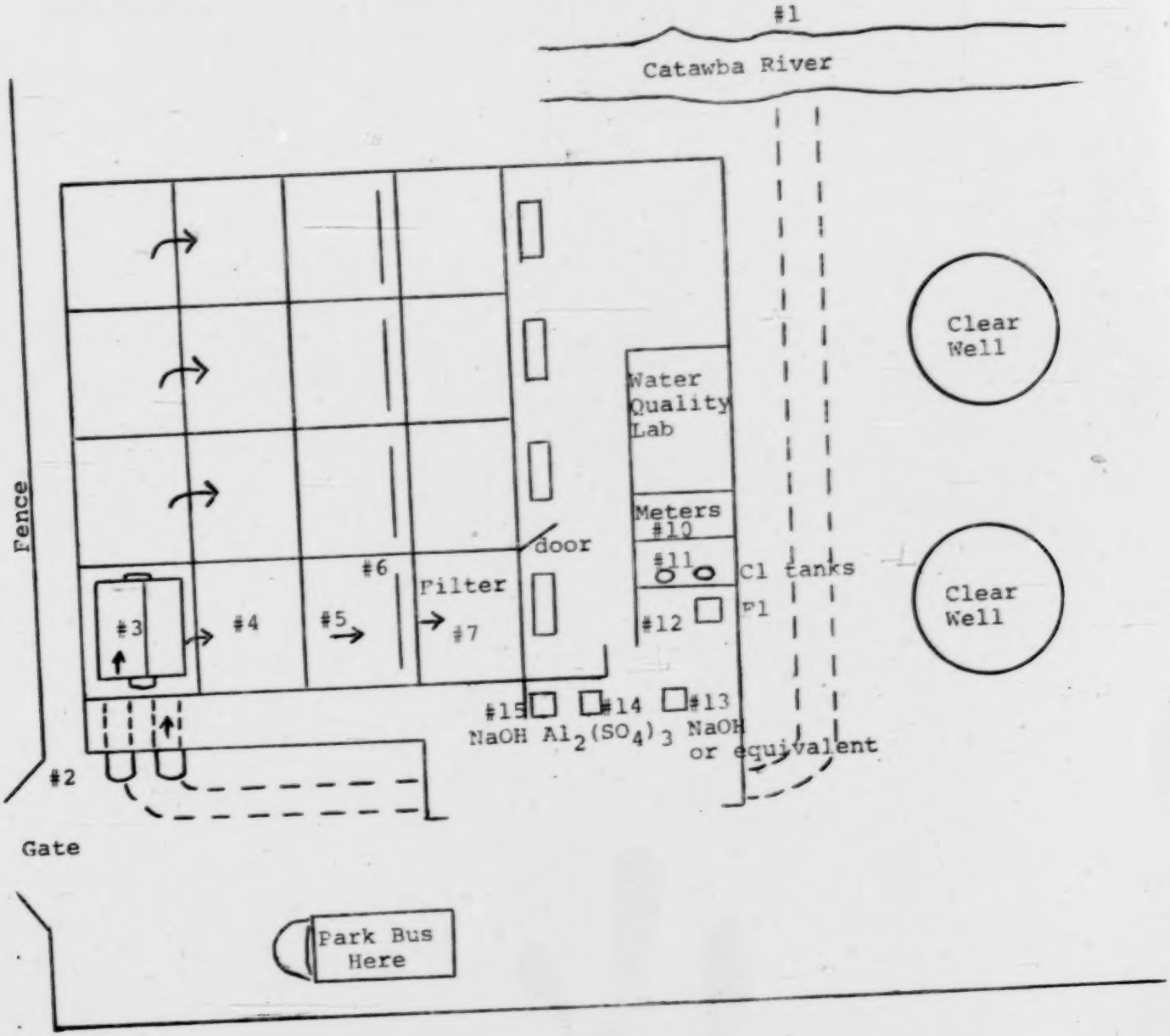
headwaters - start of river or where it begins

Catawba River - begins at Lake James and runs into South Carolina. Morganton and surrounding communities use this river for their water supplies.

Lake James - man-made lake between the Linville River and Catawba River

Linville River - runs from Grandfather Mountain and feeds Lake James

In touring the plant you may wish to refer to the following diagram:



A. The raw water is pumped from the Catawba River a few hundred yards from the plant at #1.

B. The raw water is pumped underneath the building at #13 and #14 where aluminum sulfate and a base are added. The base neurtalizes the small amount of acid that is present in natural water. This is done to prevent corrosion on pipes and pumps that the acid would otherwise cause. It is then pumped into the first row of tanks through the two black iron pipes you see emerging from the pavement at #2.

C. 1/12 of the raw water, containing $Al_2(SO_4)_3$ is pumped into the tank at #3. Here, a paddle wheel constantly stirs the $Al_2(SO_4)_3$ in with the water. This produces flocculation. The small brown clumps you see are called floc. This process removes particulates that are suspended in the water.

D. The raw water now moves toward the building (#14 & #15). As it flows through the holes in the brick you can see underwater the floc begins to settle out. The water passes over a metal wall, or weir, and into the last tank at #7. At this point the water flows downward removing the last traces of floc, mud, and dirt. This filter is composed of layers of sand and glass beads. As you would probably guess, the system must be periodically cleaned out when the floc and mud accumulate too much. This is done by reversing the water flow in the tanks and filter and flushing the floc back into the river. This water is called wash water.

E. Now enter the door in front of filter at #7. Stop at #8. As you look down through the hall you will see six consoles with levers on top of each one. These levers are attached to valves under the panel. They control the filter directly in front of the console. Do not touch any of the handles. In a few minutes you will be directly underneath where you are standing and can see the pipes that enter the console.

F. Look directly behind you at #9. This is the water quality lab. Here, water from each tank is periodically checked for certain qualities by the highly trained plant technicians.

G. To the right of the lab you will see a room filled with gauges, meters, and graphs (#10). This room contains electronic machines that tell where the water is going, how much suspended mud is still in it, the level of water in the storage tanks in Morganton, and the level of water in clearwell tanks just outside the building. If you have any questions about the individual meters, etc., please ask the technician on duty.

H. Move to the right of #10 and you will see the chlorine room (#11). DO NOT ENTER!

Water with mud in it would be safe to drink as long as the pathenogenic bacteria were removed. For this reason, the addition of chlorine is the most important step in the water cleaning process. Organisms such as typhoid, colon bacteria, and dysentery amoeba are killed by small amounts of chlorine added to the water. All these organisms get into the water by man's carelessness. Most are the result of human sewage in or near the upstream water supply. Chlorine is a highly poisonous element. The green you see in the glass domes is chlorine gas. The chlorine combines with other chemicals in the water so that it is safe to drink when it gets to your house.

I. Now enter the room to the right. At location #12 you will see a machine in a cage adding a chemical. This is where ions of fluorine are added. Most scientific evidence indicates that fluoridated water helps prevent tooth decay. Natural water in this area is low in fluoride so it is added by man. If you get your water from a well instead of city water you probably don't get much fluorine. After the fluorine is added the water is no longer "raw" but is, instead, called "finished" water. The water is now pumped to homes, businesses, and industries for use.

J. The three other machines you see at #13, #14, and #15 add $Al_2(SO_4)_3$ and sodium hydroxide (base) to the raw water. The white powder is the base and the off-white pebbles are the $Al_2(SO_4)_3$.

K. Now proceed downstairs to the pump room. You may notice the pipes are color-keyed. The blue pipes carry finished water, the orange pipes carry wash water, and the green pipes carry raw water.

L. Proceed out the side and back to the bus.

SOME IMPORTANT THINGS YOU SHOULD KNOW RELATING TO THE WATER PLANT

1. The sources of city water in Burke County are the Catawba River and the South Mountain Watershed. Burke citizens are fortunate in that they live very close to the headwaters of the Catawba. Hence, the water supply's main pollutant is mud. People who live further downstream get much more serious types of pollution in their drinking water from industrial waste upstream. The watershed area is naturally purified.

No one is allowed in the area. This results in a supply that is free of industrial waste. The Catawba River comes primarily from Lake James. The Lake's main source of water is the Linville River which flows through the Linville Gorge Wilderness Area. The Linville River gets its start in the Linville Community and Grandfather Mountain Area. There are a few industries, communities, and other sources of man-made pollution upstream from the water plant, but they are relatively few at this time.

2. The total finished water output by both water plants and the watershed is about 8 million gallons per day. Of this total output, homes, stores, and farms use about 1 million gallons per day while industry uses about 7 million gallons per day. Some of the largest industries such as Great Lakes Carbon use one million gallons per day.

3. Normally, demand for processed water does not exceed supply. However, should a shortage occur on certain days, five hundred thousand gallons are stored in each of the "clearwells" located outside the plant.

4. It is important to understand that the filter plant in Burke County only removes particulates (mud, etc.), acid and disease causing organisms. It does NOT remove phosphates, pesticides (DDT, DDE, CHLORDANE, 2-,4,-5-T, DELDRIN, etc.), heavy metals (lead compounds, mercury, arsenic, cadmium, etc.), or the other myrid of man-made chemicals that are dumped into the natural environment. These chemicals will go through the plant and be present in the finished water that you use at home for drinking, washing, and cooking.

ENVIRONMENTAL CONCEPTS -- WATER TREATMENT

Directions: Put a check mark on the blank in front of correct answers. More than one answer can be checked as some questions have several correct answers.

1. Water entering the treatment plant comes from
   _____ river
   _____ underground stream
   _____ well

2. Who uses treated water from this plant?
   _____ homes
   _____ industries

3. Most of the water from this plant is used by
   _____ industry
   _____ homes

4. Aluminum sulfate is the first chemical added to the water at this plant. It is added to
   _____ remove small pieces of dirt
   _____ kill germs

5. Does this plant add sodium hydroxide to neutralize acid water?
   _____ yes
   _____ no

6. Chlorine is added to the water to
   _____ kill germs
   _____ remove mud
   _____ make water taste good

7. Fluorine is added to water at the plant to
   _____ kill germs
   _____ remove mud
   _____ prevent tooth decay

8. This plant removes
   _____ mud
   _____ mercury
   _____ germs
   _____ pesticides

List the steps in treating Catawba River water.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

Name two chemicals added to our drinking water.

1. _____
2. _____

EDUCATIONAL EXPERIENCES PROGRAM

A TOUR OF THE MORGANTON SEWAGE TREATMENT PLANT

By

Judy Keever

Environmental Ecological Education
Burke County Title III
Richard A. Peck, Director

OBJECTIVES

1. Students will observe and list seven steps in treating human liquid waste at the sewage plant.

2. Students will list one chemical added to human liquid waste at the sewage plant.

3. Students will list the only major solid material removed from human waste at the sewage plant.

Human waste is both solid and liquid. The solid waste is called feces or many four letter words; the liquid, urine. Human waste is treated and the remaining liquid is dumped back into the natural water supply. Solid waste is removed and handled separately.

To arrange a field trip to the plant, contact Wastewater Treatment Plant, phone number -437-4194, located on Kirksey Drive, or phone Mr. Carl Hennessee - 437-8863, extension 37.

There are a few safety factors to consider when visiting the sewage plant.

1. Keep the group together.
2. Do not let students fall into tanks.
3. Do not throw foreign materials into tanks.
4. Do not tamper with any controls.

GLOSSARY

solid waste - solid human waste is called feces. Other solid wastes entering the plant are sand, paper, gum, or any other materials flushed down the toilet.

anaerobic bacteria - micro-organisms that can live with little or no oxygen for respiration (to breathe)

feces - human body solid waste containing unusable material

urine - human body liquid waste high in nitrogen composition

settling tanks - tanks where solid human waste is separated from liquid human waste as skimmer removes solids

trickling filters - liquid wastes are sprayed over bacteria covered rocks where some organic wastes are broken down and removed from solution by aerobic bacteria

chlorine gas - added to liquid wastes to kill some micro-organisms in the water

aerobic bacteria - bacteria that, like people, need oxygen to respire (breathe). Aerobic bacteria on the trickle filter rocks remove organic wastes as their food.

methane gas - a by product of anaerobic breakdown of organic material. This incomplete breakdown results in a combustible gas, methane.

compost - solid wastes after anaerobic bacteria have removed much organic matter. This dried material has micro-organisms such as bacteria, some minerals, and bulk waste as its major components.

weir - wall over which liquid wastes flow in settling tanks

Human waste is treated in many ways: the pit-privy, septic tanks, flows into streams, or at treatment plants. There are three types of sewage treatment plants.

1. primary - separates liquid and solid waste

2. secondary - separates liquid and solid waste - kills bacteria

3. tertiary - at the end of the secondary treatment a third stage is added - a retaining or natural pool is formed and the water is treated by natural processes

The best system is the tertiary system because it returns water to its cleanest, most natural condition.

The Morganton plant is a secondary treatment plant.

SOLID WASTE TREATMENT

Sewage is transported by gravity through a network of pipes to the sewage treatment plant. When the commode is flushed the waste is washed into pipes leading through the system to a central point.

1. As the sewage enters the plant the solid waste is ground by large blades and pumped to storage tanks.

   (Numbers in parentheses refer to plant diagram - page 5)

2. Sand settles out here. (11) In these tanks anaerobic bacteria are added to the solid waste. Anaerobic bacteria, which do not need air in order to grow, use the solid waste for food. A chemical reaction takes plance between the solid sewage waste and the bacteria. Because of this reaction methane gas is produced. Usually to get rid of this gas it is burned. (That is the flame which can be seen coming from the large tanks). Methane gas produced here is used to heat the plant building. Water is then added to waste and pumped to drying beds. (12) The beds are covered with sand, then the waste. This will form a compost when dried. After the waste is dried it is then shoveled on a conveyer belt which dumps the compost into a truck. The truck then dumps the waste. Human waste can be recycled to be used as fertilizer on plants which grow above the ground.

LIQUID WASTE TREATMENT

The liquid body waste enters the sewage plant as the solid waste does. (1) (2) At the point of entry a machine is used to sift sand from the liquid waste. For some reason sand will foul the system.

(3) The liquid then flows into settling tanks (8 feet deep) where some of the solid waste which was not pumped off at the entry is now removed from the top by a revolving arm. The solid waste is dropped down a shoot. The liquid then flows over a weir into a trough which takes the waste to trickling filters.

(4) The trickling filters are large circular filters which are filled with a bed of rocks which is 3 feet deep. Aerobic bacteria are grown on the rocks. The bacteria use the liquid waste for food. As the liquid flows through the rocks the bacteria helps to cleanse the waste.

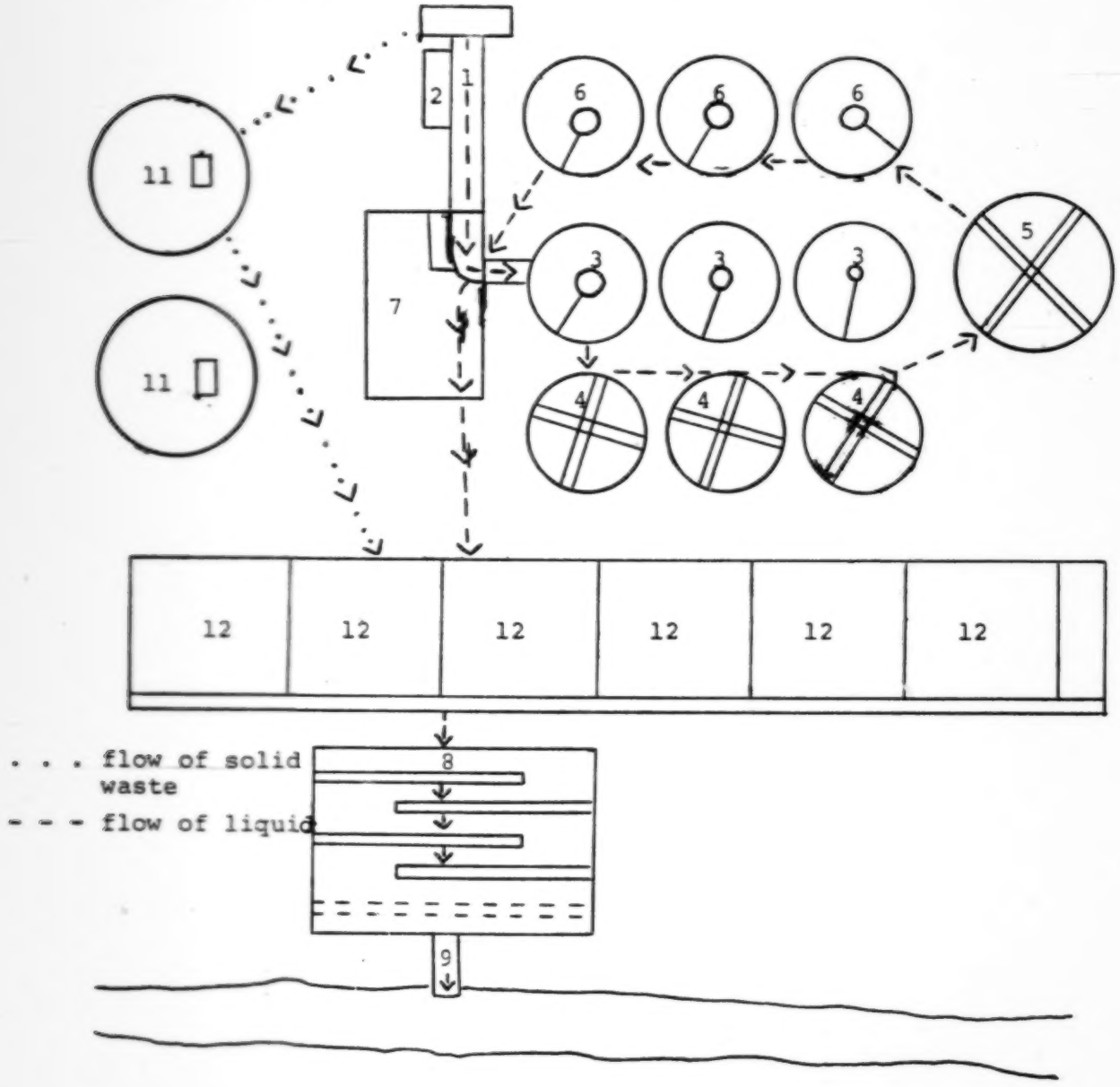
(5) The liquid then flows to a larger or primary trickling filter. This filter is 5 feet deep. Again aerobic bacteria cleanse the liquid.

(6) The liquid is again pumped to settling tanks, eight feet deep. Again any solid waste is removed from the surface by a rotating arm. The liquid flows over a weir into a trough.

(7) The liquid then flows under the plant. In the plant chlorine is added to the water to kill all bacteria. Bacteria are the only harmful substances removed from the liquid.

(8) The liquid flows into a pool. The pool has a weir made of concrete walls. These walls slow the flow so that nature can help cleanse the waste.

(10) The waste then flows into a creek which leads to the Catawba River.



Plant Directory

1. Entrance - All sewage pipes have converged into one - solid and liquid waste are separated here.
2. Sifter - machine that removes some sand from the liquid waste.
3. Settling tanks - liquid is settled out here and solid waste is removed from the surface.
4. Trickling filters - here liquid flows from revolving pipes over rocks covered with aerobic bacteria
5. Primary trickling filters - same type filter as trickling filter
6. Secondary settling tanks - same type tank as primary settling tanks
7. Plant office and lab - here chlorine is added to liquid waste
8. Pool - where flow of water is treated by nature before entering creek
9. Pipe - where water flows from plant into creek
10. Creek - from here water then flows to Catawba River
11. Storage tank - solid waste is pumped here and anaerobic bacteria added
12. Drying beds - solid waste dried by air in open tanks

Points of Interest

Often this plant cannot treat the overflow of sewage; therefore, raw (untreated) sewage is dumped into local streams.

The river into which the water runs is used for drinking, fishing, swimming, boating, etc.

This plant does not remove any chemicals such as arsenic, lead, mercury, and pesticides from the water. Local industries are not allowed to dump chemicals into the sewage system. Occasionally, illegal dumping does occur. Plants will dump small amounts into local streams. Often they are hauled in containers to the dump areas to be buried with solid waste. Or plants sneak them into the sewage system in small amounts so their presence cannot be detected. These chemicals are not removed by the sewage plant. Therefore, they are dumped into the river harming any living things which are in contact with the water.

Phosphates (detergents) are not removed from the sewage water and are dumped into the river.

The plant removes no harmful substance from the water except bacteria.

ENVIRONMENTAL CONCEPTS -- SEWAGE TREATMENT

Directions: Put a check mark on the blank in front of correct answers. More than one answer can be checked as some questions have several correct answers.

1. This plant is a
   _____ primary treatment plant
   _____ secondary treatment plant
   _____ tertiary treatment plant

2. Which type plant cleans the water best?
   _____ primary
   _____ secondary
   _____ tertiary

3. Does raw (untreated) sewage ever pass through and get dumped into the creek?
   _____ yes
   _____ no

4. This plant removes
   _____ mercury
   _____ poisons
   _____ phosphates
   _____ most solid waste sewage

5. Which chemical is added to kill germs?
   _____ aluminum
   _____ chlorine
   _____ sodium
   _____ fluorine

List the steps in treating human liquid waste.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____

Name the chemical added to human liquid waste.

_____

What major solid material is removed from human waste at the sewage plant?

_____

EDUCATIONAL EXPERIENCES PROGRAM

THE BURKE COUNTY LANDFILL

By

Michael Forney

Environmental Ecological Education
Burke County Title III
Richard A. Peck, Director

THE BURKE COUNTY LANDFILL

We are all faced with the uniquely human problem of garbage disposal. Every day in the U. S. each individual produces two pounds of garbage. With over 200 million people in this country, garbage has become a problem of real concern. Man must begin to reclaim some of his garbage or it will bury us.

EDUCATIONAL OBJECTIVES

1. Students will be able to explain two differences between a dump and a landfill.

2. Students will be able to list two problems involved in a landfill operation.

In most cities and towns in the past burning garbage has been a widely accepted method of reducing the volume of garbage. However, this creates air pollution. In large industrial cities where air pollution is worst, burning garbage simply adds to the problem.

The most widely accepted method of garbage disposal at the present is the LANDFILL. Essentially this method of disposal buries garbage. A layer of solid waste will be covered by a layer of dirt which will be covered by a layer of solid waste and so on. The landfill, if operated properly, is clean and neat. No garbage is visible at the end of the day's operation. Unfortunately, few landfills meet these standards.

Components of solid waste:

What sort of things do people and industries throw away? Let's examine them.

1. METAL - Every day tons of metal are thrown away. Aluminum cans, oil drums, junked cars, etc. Beer and soft drink cans alone make up a high percentage of all the garbage at the landfill.

2. PLASTIC and PLASTIC PRODUCTS - Plastic bags, milk containers, toys, coverings, and many other sorts of plastic materials are thrown away every day.

3. WOOD and PAPER PRODUCTS - Newspapers, magazines, cardboard boxes, packing crates, discarded lumber, old furniture, etc., make up a large part of our garbage.

4. GLASS - Glass containers, light bulbs, bottles, and other glass products are thrown away.

5. RUBBER PRODUCTS - Products such as tires make up part of our solid waste.

6. CHEMICALS - Some companies dump chemicals at the landfill. This can cause a serious problem if these chemicals percolate through the soil and into drinking water sources.

7. FOOD and ORGANIC WASTE - These products are essentially beneficial to the soil as they contain materials that will break down (bio-degrade) and return to the soil.

PROBLEMS IN THE LANDFILL CONCEPT

The landfill is not a solution to the solid waste problem. First of all there is only a limited amount of land available for burying garbage. In Morganton the landfill is rapidly running out of room after just two years of operation. To make an area of land suitable for a landfill trees must be bulldozed off the land.

Secondly, garbage can pollute the soil. Chemicals such as arsenic and mercury can pollute soil beyond any useful productivity. An area of land that has been used for a landfill is of little use for housing until the soil has settled -- a process that may take several years.

Solutions

The problem is that there is simply too much garbage to be adequately handled. The solution seems to be to cut down on the amount of solid waste that we as a society produce.

One solution is recycling. Most solid waste can be reclaimed and reused. Glass, metal, paper and wood, can all be recycled. In other words we must redefine solid waste. Is an empty can "waste"? Not if it can be smelted down, reformed and reused. This process of recycling would cut down on the amount of new metal needed and would make use of resources already in circulation. Recycled paper saves trees that might otherwise be cut to make new paper.

Plastics (specifically polyvinyl chloride) can not be recycled. They will not decompose or change physically or chemically. One solution to this part of the solid waste

problem is to use glass or paper packaging rather than plastics. For example, paper bags rather than plastic could be used to store food and other consumer goods.

One of the reasons we (Americans) produce so much garbage is that we consume so much. If each individual made an effort to consume just a little less and to throw away a little less, the amount of garbage could be significantly reduced.

Industry -- It should be pointed out that the major volume of garbage is industrial waste instead of household waste.

If the solid waste problem is to be solved then industry must do its part.

ENVIRONMENTAL CONCEPTS -- LANDFILL

Directions: Put a check mark on the blank in front of correct answers. More than one answer can be checked as some questions have several correct answers.

1. Which kinds of solid waste could be recycled?
   _____ plastic
   _____ glass
   _____ metal
   _____ wood and paper
   _____ food

2. To be classified as a landfill
   _____ the trash must be covered with soil daily
   _____ trash disposal must be supervised by law enforcement people
   _____ no regulations are needed

3. This landfill site will eventually
   _____ fill up
   _____ be used over for trash dumping
   _____ disappear in thin air

4. Poisonous chemicals dumped here could
   _____ appear in the nearby creek
   _____ poison plants in the area

List two differences between a dump and a landfill.

1. _____

_____

2. _____

_____

Name two environmental problems involved in a landfill operation.

1. _____

_____

2. _____

_____

ENVIRONMENTAL EXPERIENCES PROGRAM

LINVILLE GORGE — AN OUTDOOR TEACHING LABORATORY

By

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Environmental Ecological Education
Burke County Title III
Richard A. Peck, Director

LINVILLE GORGE — AN OUTDOOR TEACHING LABORATORY

Linville Gorge is a 7,600 acre tract of land set aside by the U. S. Forest Service as a wilderness area. This area offers some unique learning experiences for public school students.

The term wilderness area means that the Gorge is essentially unchanged by man. The rugged nature of the Gorge made it difficult to travel through and inconceivable for farming or settlement. The hostile nature of this environment is the only thing that has kept it free of man's intervention.

True wilderness is a rapidly vanishing environment, and one that offers a vivid contrast to the problems of heavily populated and polluted areas. Linville Gorge is a virgin forest in its climax stage. Many students will never experience what this sort of environment is like.

The Linville River actually begins on Grandfather Mountain. The tremendous scouring action of the river has carved a deep, rugged gorge rimmed with some of the oldest rock formations in the world.

EDUCATIONAL OBJECTIVES

Any trip to Linville Gorge should be aimed at acquainting students with a wilderness environment. Methods or specific objectives may vary but it should be stressed that students are entering a unique area that can be all too easily destroyed. Wilderness is fragile. With today's modern technology man has the power to change the environment very rapidly. Nature works slowly over hundreds and thousands of years. Nature simply can not repair itself as quickly as man can destroy it.

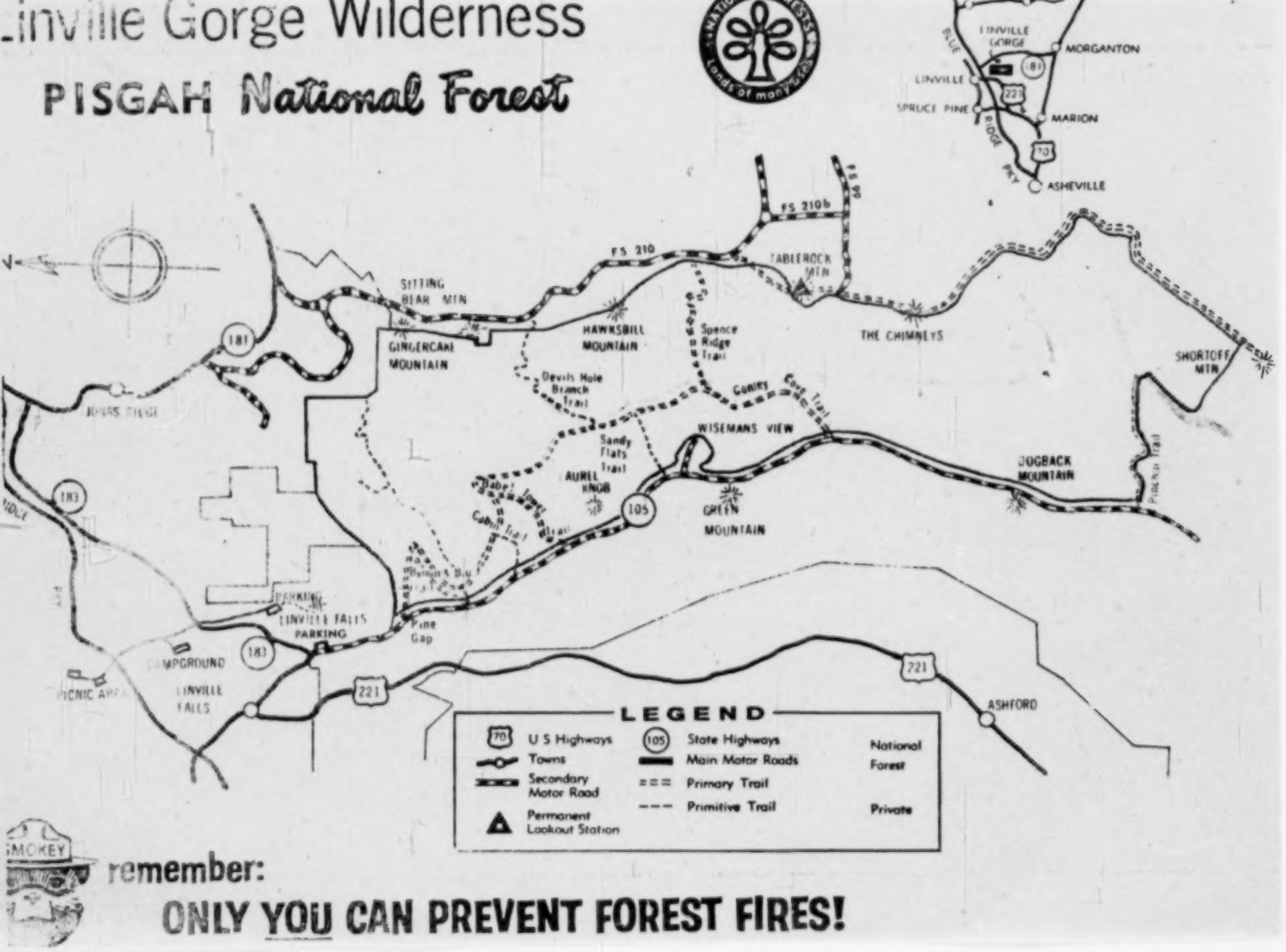
Entry To and Exit From the Gorge

Linville Gorge is not easily accessible. This is one of the reasons it is still a wilderness area. The most accessible trail into the Gorge is Spence Ridge Trail. From Table Rock the Gorge can be observed without actually going into the wilderness area.

The map provided shows existing trails and places to view the Gorge. Hikes of any length can be taken around or into the wilderness area. See Map for detail.

Linville Gorge Wilderness

PISGAH National Forest



remember:

ONLY YOU CAN PREVENT FOREST FIRES!

SPECIFIC SUBJECT AREAS

The variety of subjects and material that can be studied in and around the wilderness area is tremendous. The areas of study mentioned here are meant to serve as a guide. You the teacher should feel free to exercise your imagination as vigorously as you like.

1. GEOLOGY

The geology of the Gorge is complicated. Essentially the Linville River formed the Gorge by scouring and weathering. The Geology of the Linville Falls Quadrangle which can be found in the public library is a good reference for some single facts about the area.

2. WATER

The Linville River is polluted. Sewage dumped into the river from private homes in Linville Falls has polluted the river. This offers a good lesson in man's carelessness with his natural resources. The EEE staff can supply water testing kits for students to test the pollution level of the river. We have two types of testing kits. One is a fairly simple test for phosphate content. The other kit (La Mott) is more complicated and can test for other pollutants such as arsenic, chloride, heavy metals, etc. This can be compared to the pollution level of streams flowing into the river which are relatively unpolluted.

3. HISTORY

Historically Linville Gorge has always been an impediment to civilization. Early settlers found it an awesome place. Students might become more aware of what settlement of the west was like by taking a backpacking trip through the Gorge.

4. WILDLIFE

The wildlife of this wilderness area is extremely plentiful. From mushrooms to raccoons there are all sorts of varieties of plant and animal life. How you choose to study this is up to you the teacher. The EEE staff can provide you with a variety of books on plant and animal life.

5. ART, MUSIC, POETRY, ETC.

The Gorge can serve as an instrument of inspiration for creative endeavors. We have had a lot of success using the wilderness area as a stimulus for poetry, writing, etc.

The staff can supply some books on Hiaku poetry, Sumi-E art, and music. Children could be asked to write a story, a poem, etc., about this area. Try to point out that nature is not always friendly and serene. It may be harsh and cruel.

6. WILDERNESS AREAS

Students should be made aware of the fragile nature of any wilderness area. Linville Gorge is subtly being destroyed. The increase in the number of visitors, the increase in trash left by thoughtless hikers, and the spread of populated areas right up to the rim of the Gorge, are all having an effect on this wilderness area.

Linville Gorge is small, only 12 miles long and about 2 miles wide in most places. It isn't hard to destroy an area as small as this. Impress upon students the fact that careless acts such as the pollution of the river could change the entire animal and plant life of the Gorge.

OVERNIGHT HIKES

If a teacher wishes to take a class camping, the staff can supply all needed camping gear and information about where to go, what to do and what to see. An overnight hike could include some of the following activities:

a. tree and plant identification
b. star study
c. map and compass study. This is an excellent vehicle for math. (How far is it from point to point? How long will it take to get there? How fast do we travel?, etc.)
d. setting up a shelter
e. campfire discussions
f. writing, art, music, poetry, etc.

RECOMMENDATIONS ON SAFETY

Be sure that students understand the implications of a trip to Linville Gorge. There are cliffs that students could wander over and the area does have two species of poisonous snakes — rattlesnakes and copperheads. Neither of these dangers need interfere with a trip if students are controlled in a sensible manner. Students who simply can't behave should be left at school.

PLEASE DO YOUR PART

Realize that every visitor to the Linville Gorge Wilderness Area is a potential enemy to the ecosystem they have come to see. Have students follow a few basic rules:

1. Do NOT harm any living thing. Don't break off plants or leaves or kill any animals.

2. Have students carry out all the things they bring in. Cans, tin foil, paper, etc., should be carried out. Try to carry out garbage left by others.

3. Try to develop in students an appreciation for natural environments.

SUGGESTED ACTIVITIES FOR OUTDOOR CLASSES

QUADRAT — Mark off a 10' square. As accurately as you can, count the number of different types of plants including fungi and lichen. Mark off another 10' square at a higher or lower altitude and count the plants there. (Examples: top of the Gorge and the area along the river, or the top of Grandfather and the bottom of the mountain.) This activity can illustrate the effects of altitude, wind, and temperature on plant (and animal) life. For every 1000' rise in elevation the temperature drops 3°. Plants must become more specialized to survive at higher elevations.

OBSERVE — Have each student sit down and list as many colors, textures, sounds, smells, or different living things as he can experience in that one spot. Specific name of organisms need not be mentioned, instead use words like flower, tree, insect, etc.

AWARENESS — Have students or class list evidence of man's influence in that area. (Bottle, paper, path).

DESCRIBE — Blindfold one student and ask him to describe an area. Size, shape, weight, texture, or temperature are categories for description. Other students might guess what blindfolded student is describing.

EDUCATIONAL EXPERIENCES PROGRAM

AIR

Ernest Morgan

Environmental Ecological Education
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Richard A. Peck, Director

Objectives for Air Unit

1. Students will list at least three major gases which are found in the earth's atmosphere.
2. Students will explain why the atmosphere is important to human existence.
3. Students will list three basic categories of air pollution.
4. Students will list one common example of each of the three basic categories of air pollution and a source of each example.
5. Students will list two ways air pollution can affect the human body.
6. Students will list one reason why the term "air pollution" is ambiguous.

AIR

This unit is designed to teach the student the fundamentals of his gaseous environment and the effects of pollutants on this environment.

Air, Its Composition and Abundance:

The earth's atmosphere is composed of a mixture of gases we call air. This thin layer of gases is held to the earth by gravity and becomes less dense, or thinner, as one gets farther from the earth's surface. As a general rule, man is forced to live in the layer between sea level and 10,000 feet. It is within this thin skin of gas that man must breathe, build his dwellings, and grow the vast amounts of food needed for a population of 3½ billion plus.

This mixture of gas we call air is composed of about 80% nitrogen, 19% oxygen, and 1% other gases such as carbon monoxide (CO), carbon dioxide (CO_2), helium, Argon, Neon, etc.

It is the oxygen that man must have in order to respire or "breathe." Oxygen is man's most immediate need. Without it the human brain will die, usually in less than 5 minutes. However, to maintain life for long periods man must have the oxygen diluted with other gases that he doesn't use. Clean air is the ideal mixture of gases. It is plentiful and it is natural.

Why does man need air? In order for any life to exist, as we know it, energy is needed. Energy is needed to enable your muscles to move you from point A to point B. Your body uses energy to send messages through your nerves. It is energy that

pumps your blood throughout your body. It is energy that sends messages through your brain, enabling you to "think." It is energy that keeps your body warm. Where do you get energy? From burning food. In order for something to burn you must have a chemical reaction of the fuel (food) with oxygen. In other words, by "burning" food you release energy stored up in it for your body to use. This is called oxidation. Your body gets oxygen to oxidize the food, from air. But remember, only about 20% of the air you breathe is the oxygen you need.

If you examine the air around you, you will find much more there than oxygen, nitrogen, CO_2, CO, etc. You will find many other things we may call air pollution. These can be grouped into three categories:

SOLIDS
GASES
AEROSOLS

Let's examine these a little more closely.

SOLIDS -- These are small particles, such as dirt, soot, ash, pieces of asbestos, rubber, glass, etc. These particles will settle out. They are often seen on the exposed cars, window sills, or other outdoor surfaces.

GASES -- These are chemicals that do not settle out, and exhibit the properties of a gas. The most common gaseous pollutants are:

Carbon Monoxide (CO) -- An odorless, tasteless, colorless gas that is highly poisonous to all higher life forms both animal and plant. CO is a result

of incomplete combustion. Its main source is the automobile engine. It is especially a problem in urban areas.

Prepare with sulfuric acid and sodium sulfite

Sulfur Dioxide (SO_2) -- A poisonous gas that usually results from burning sulfur or sulfur products such as high sulfur coal in generating electricity. It is colorless, and has a pungent suffocating odor. Contact with water and oxygen will yield H_2SO_4.

Demonstrate by action of nitric acid on copper, silver, etc.

Nitrogen Oxides (NO_x) -- Little is known about the effects of nitrogen oxides on ecosystems. It is known that some forms such as NO_2 are toxic to man. It is a reddish brown color which fades on cooling. It unites with water forming nitric acid.

Show samples of cracked rubber and demonstrate with electric drill

Ozone -- Ozone is another form of the oxygen molecule. It is highly toxic to living organisms. It is also the principal reason that rubber rots and cracks. It is produced by electric drills and lightning and is found in the upper layers of the earth's atmosphere.

Demonstrate by production of acetelene gas (smell), gasoline, kerosene, alcohol, ether

Hydrocarbons (Photochemical Smog) -- There are hundreds of compounds containing hydrogen and carbon. They present a problem when sunlight hits them. The short ultraviolet waves change them to different compounds producing what is labeled photochemical smog.

Prepare by putting HCL on Ferrous Sulfide

Hydrogen Sulfide (H_2S) -- Hydrogen Sulfide is a colorless, very poisonous gas that smells like rotten eggs. Small amounts cause nausea and headache, larger amounts cause burning of the eyes and collapse.

AEROSOLS -- Aerosols are particles of solids or liquids that are so small they won't settle out of the air. There are many types ranging from dust, dirt, and carbon, to such things as water vapor, lead, nickel, cadmium, rubber particles, paint, etc. Aerosols may be cleaned out by rain, snow, or plant and animal respiration.

Now that you have seen some of the various types of air pollution, let's look at some of the sources.

The automobile -- is the main source of air pollution. The family car contributes about 6 lbs. of pollutants to the air each day. Car exhaust is the main source of photochemical smog and nitrogen oxides. It also produces lead pollution from tetraethyl lead added to gas. Lead is unburned so all is given off in emissions - lead slow burning (knock). When the car engine is running poorly or at low speeds not enough oxygen is taken in to burn the gas completely. This produces carbon monoxide in large quantities. Every time a driver applies the brakes tiny particles of asbestos fly off into the air. Microscopic pieces of rubber constantly fly off the tires. The tires also stir up dirt and dust that has settled onto the road surface. Another source of air pollution from cars occurs from spilling gasoline when "tanking up" and from evaporation at the gas cap. These are hydrocarbon pollutants.

Demonstrate percipitators

Electric Generating Plants -- produce several types of air pollution. Fly ash and soot can be reduced by electrostatic percipitators. However, gases are more difficult to remove. Many generating stations burn coal with a high sulfur content thus producing large amounts of SO_2. Since coal is a mixture of many elements and compounds it contains traces of such poisonous elements as lead, arsenic, mercury, and cadmium. When this coal is burned these traces of poison go out the smokestack into the air.

Industry -- Industry produces a myriad of air pollutants. There are at least several hundred different chemicals that spew into the air from cement, plastic, medicinal, paper, textile, paint, furniture, glass, asphalt, refinery, steel, and machine factories.

Home Heating Systems -- Fly ash, soot, and sulfur dioxide are probably the most serious pollutants produced by home furnaces, fireplaces, etc. If your home has electric heat or water heat it means the air pollution is being produced at the electric plant instead of directly in your house.

Other sources of air pollution include:

A. Burning trash at city and private dumps
B. Burning leaves and trash wood
C. Burning fields for clearing weeds
D. Forest fires
E. Dust storms on barren soils
F. Radioactivity from nuclear power plants
G. Smoking cigarettes, pipes, and cigars

AIR POLLUTION CHART

POLLUTANT	MAIN SOURCE	EFFECT ON HEALTH	MINIMUM STANDARDS	ERA'S RECOMMENDED ACTION
Sulphur Oxide	Electric plants, Coal-burning factories	Irritates respiratory tract; damages lungs	80 Micrograms per cubic meter as the annual mean	Shift to natural gas (would require 300% Increase in some cities)
Particulates	Smoke, soot, fly ash from factories, power plants	Damage lungs, cause gastric cancer	75 micrograms per cubic meter as the annual mean	Burn cleaner fuel
Carbon Monoxide	Automobile, trucks, buses	Slows reactions; puts extra burden as anemic people, damages heart	9 parts per million maximum 8-hour concentration once/year	New devices for auto engines; limit traffic in some cities
Hydrocarbons	Refineries and automobiles	Not toxic, but contribute to smog	0.24 parts per million maximum in 3 hours, once a year	Automobiles must reduce hydrocarbon emission by more than 90% by 1975
Nitrogen Oxides	High temperature combustion in engines, furnaces	Increase susceptibility to influenza	0.05 parts per million as the annual mean	Automobiles must start reducing nitrogen oxide emission by 1973; reducing to 90% by 1975
Photochemical Oxidants	Sunlight on hydrocarbons and nitrogen oxides from engines, furnaces	Irritates eyes, increase asthma attacks	0.08 parts per million maximum 1 hour concentration each year	New automobile standards will help. Chang industrial processes

Dirty air costs your family $309 per year. Average American's share is $80 per year.

Pollution changes climate: cities create thermal mountains, making cities warmer and wetter; winter temperatures up 2° to 3°; rainfall up to 5 to 10%; cloudiness up 5 to 10%; winter fog up 100%; wind speed 20 to 30% lower.

Clean fuel is scarce; Federal air standards will require 15% more clean burning natural gas. Demand tripled in last 20 years; known world reserves will last only 13 years. Gasification of coal should help some. Natural gas: 13 year supply. Oil: 30 to 35-year supply. Coal: 350- to 450-year supply.

Air pollution kills. Death rates from disease associated with air are climbing.

Air and Health

The incidence and distribution of disease as it relates to air pollution has been studied vastly. A mass of information has been accumulated showing its undesirable effects. However, we are asking the wrong question when we try to draw from this body of information a series of numbers describing safe concentrations of individual pollutants. People (and other things) are living, breathing, constantly changing bodies, each with its own hereditary and environmental history. To consider the effects of air pollution on living things one must take into account the synergistic effect of pollutants (whereby the total effect of a combination of pollutants is greater than the sum effect of individual pollutants), the changing effects of pollutants with changing weather, or the reinforcement of an airborne pollutant's effects when the same material reaches people by other environmental pathways. THE WORST PATHOLOGICAL EFFECTS OF ENVIRONMENTAL POLLUTANTS MAY NOT BECOME EVIDENT UNTIL SEVERAL DECADES AFTER EXPOSURE.

How the Body Clears Pollutants

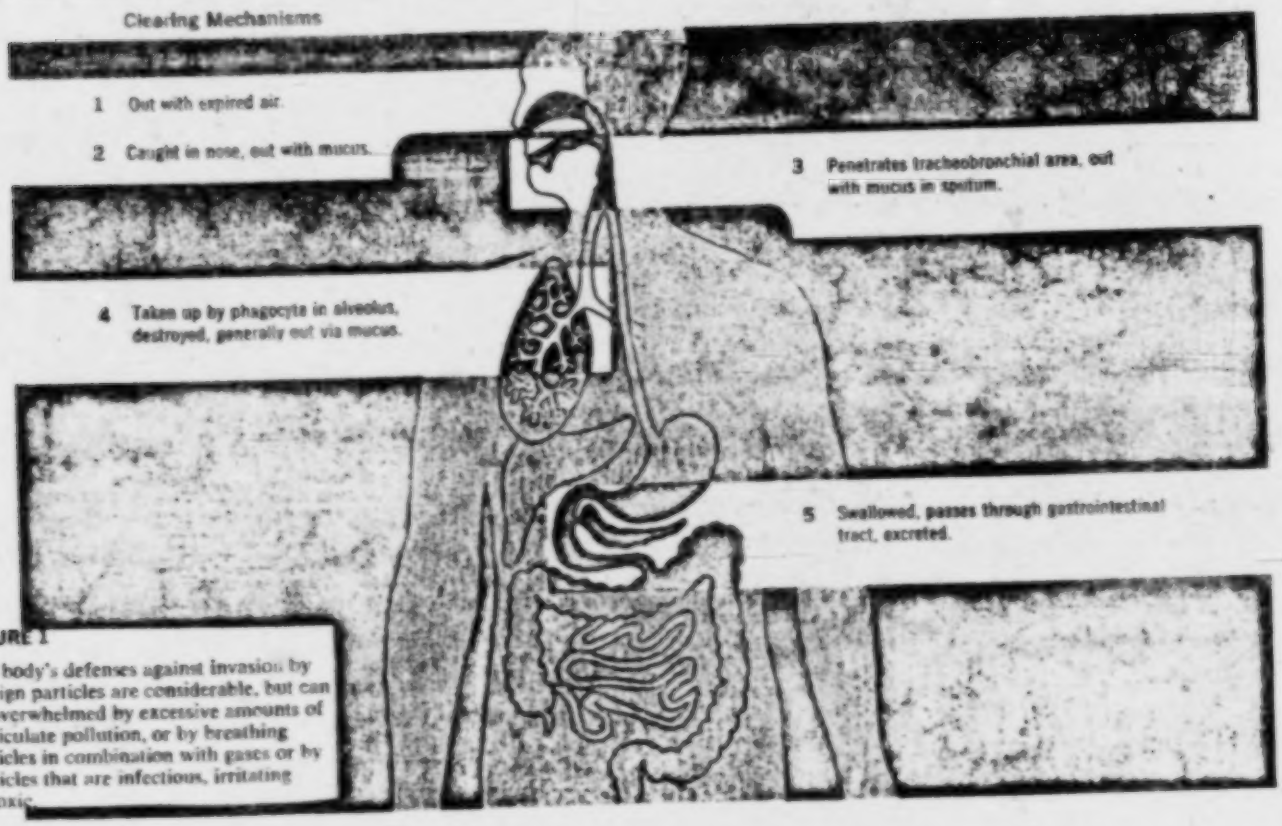
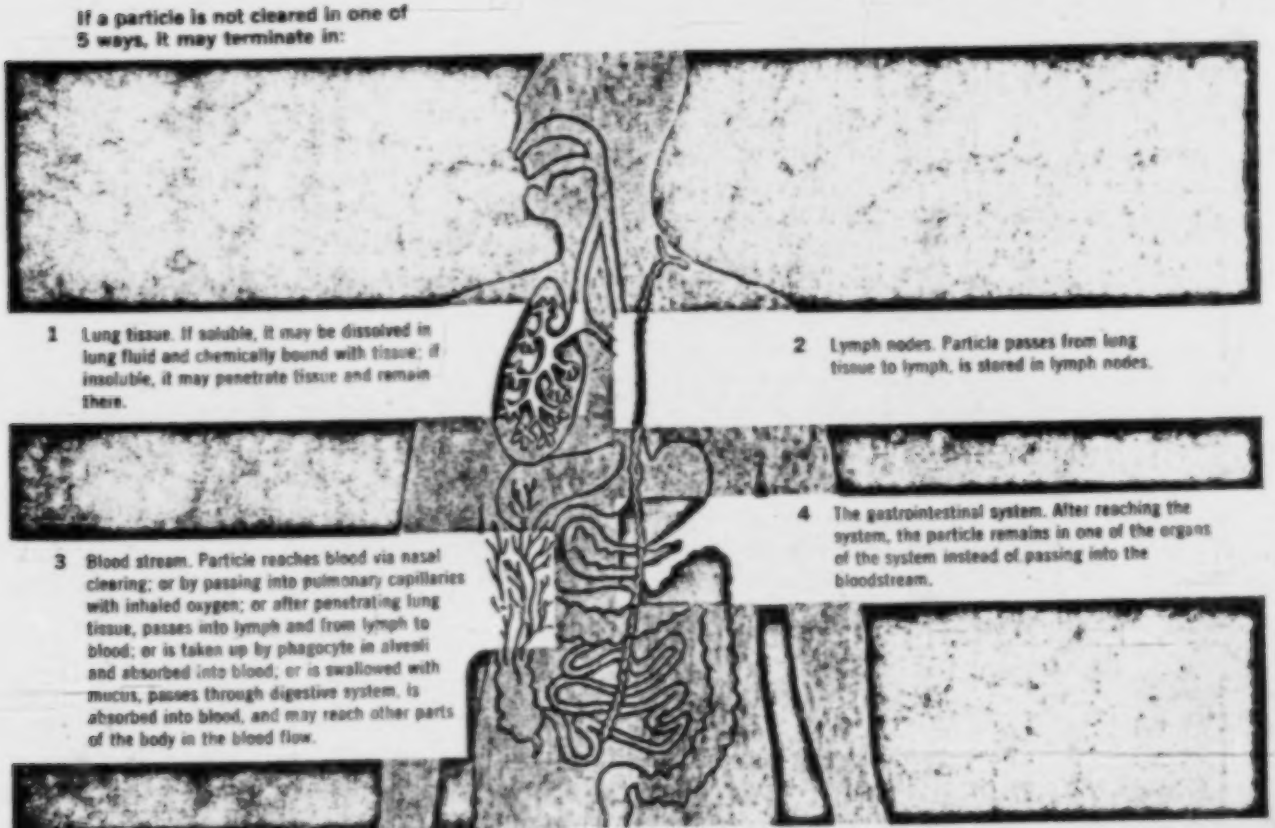

Clearing Mechanisms
1 Out with expired air.
2 Caught in nose, out with mucus.
3 Penetrates tracheobronchial area, out with mucus in sputum.
4 Taken up by phagocyte in alveolus, destroyed, generally out via mucus.
5 Swallowed, passes through gastrointestinal tract, excreted.

FIGURE 1

The body's defenses against invasion by foreign particles are considerable, but can be overwhelmed by excessive amounts of particulate pollution, or by breathing particles in combination with gases or by particles that are infectious, irritating or toxic.


If a particle is not cleared in one of 5 ways, it may terminate in:
1 Lung tissue. If soluble, it may be dissolved in lung fluid and chemically bound with tissue; if insoluble, it may penetrate tissue and remain there.
2 Lymph nodes. Particle passes from lung tissue to lymph, is stored in lymph nodes.
3 Blood stream. Particle reaches blood via nasal clearing; or by passing into pulmonary capillaries with inhaled oxygen; or after penetrating lung tissue, passes into lymph and from lymph to blood; or is taken up by phagocyte in alveoli and absorbed into blood; or is swallowed with mucus, passes through digestive system, is absorbed into blood, and may reach other parts of the body in the blood flow.
4 The gastrointestinal system. After reaching the system, the particle remains in one of the organs of the system instead of passing into the bloodstream.

A Brief Sketch on Air Pollution's Effect on the Body:

Mouth breathing allows pollutants to bypass the body's first defenses.

Sulfur dioxide is removed efficiently by the nose at high concentrations but slips through and penetrates the lung at low concentrations.

Particles that penetrate all the way to the alveoli--tiny air sacs at the ends of the air passages--may be engulfed by scavenger cells (phagocytes). Enzymes in these cells permit the cells to digest and liquefy some particles. Cigarette smoke has a toxic effect on the scavenger cells, and an inorganic mineral particle cannot be destroyed by a phagocyte that has taken it in; on the contrary, the phagocyte may be destroyed by the particle. The induction of the enzymes that make the scavenger cells work may be inhibited by carbon monoxide, thus lowering the effectiveness of the lung's defenses.

Particulates may harm the body as long as they remain in it, even though they have been cleared from the pulmonary system. The mucus is continually swallowed and carried with its load of impurities into the gastrointestinal tract. This process is necessary for the elimination of the particles, but along the way opens the door to damage to the digestive organs.

Nitrogen dioxide is one of the gases that is low in solubility and is therefore not removed in the nose. It penetrates the lower respiratory tract and lowers resistance to bacterial and viral infections.

Ozone has been found to impair the ability of phagocytes to trap streptococci.

Silicosis, which is caused by the inhalation of dust containing a high proportion of silica, is the best known of the chronic diseases of the lung arising from dust exposure, but there are a number of others collectively referred to as the pneumoconioses.

Asbestos is only one of well over 100 different natural minerals that are fibrous in structure. Breathing of these fibers may result in a disease known as asbestosis.

Cancer is a major disease which may arise from inhalation of certain gaseous or particulate pollutants, alone or in combination. For example, lung cancer like that in humans has been induced in animals by the inhalation of the hydrocarbon benzpyrene in combination with sulfur dioxide. While most attention has been focused on lung cancer, an association between air pollution and stomach cancer has also been found.

Lung cancer has been produced when animals have been infected with influenza virus and exposed to artificial smog.

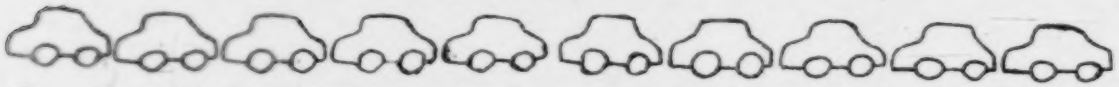
Mutations have been produced in bacteria by sulfur dioxide pollution.

Radiation is known to cause mutations. The discovery that ozone is radiomimetic, that is, that it "mimics" the mode of action and biological effects of radiation, resulting in premature aging and chromosmal injury, makes ozone suspect as both a carcinogenic and mutagenic agent.

Air Pollution -- A Roadside Study

Directions: Choose a busy highway. Take five microscope slides and smear them lightly in the center with Vaseline. Place one face-up at the curbside. Then, pace off ten steps and place another. Continue pacing off ten steps and placing a slide until you have placed all five slides. Then, choose a safe spot and observe the passing cars for 30 minutes. While observing the cars try to answer the following questions.

1. Put a number on each car telling how many people are in each of the next ten cars or light trucks.



2. The total number of occupants for all ten cars was _____.

3. What are your ideas and feelings about the above statistic?

_____

_____

_____

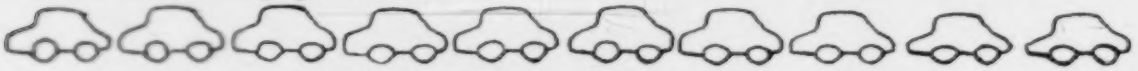
_____

4. Close your eyes and smell the air. Inhale deeply and SMELL! Describe the odor of the air.

_____

_____

5. Put a check in each of the next ten cars or light trucks that pass that have any visable smoke or emissions coming from the cars exhaust pipes.



6. How many cars had visible emissions? _____

7. List any ways the passing cars are causing air pollution other than from the exhaust pipes.

   1. _____ 2. _____

   3. _____ 4. _____

8. List any other types of pollution the passing cars are causing.

   1. _____ 2. _____

   3. _____ 4. _____

9. Now, after 30 minutes, gather up the slides carefully, labeling them 1 thru 5 starting at the road edge. Observe the slide under a microscope or hand lens. Try to represent the particulate pollution you see by making dots in the squares below.

Nearest road ☐ ☐ ☐ ☐ ☐ Fartherest from road

EDUCATIONAL EXPERIENCES PROGRAM

NOISE POLLUTION

Judy Keever

Environmental Ecological Education
Burke County Title III
Richard A. Peck, Director

NOISE POLLUTION

Teaching Format:

The Ear:

Parts of the ear.
Functions of the ear.
How the ear works.

Facts:

Select facts which you want your class to know. Try to emphasize the facts with an activity or illustration.

Activities:

Select activities geared to the level and interest of your class. If possible, the use of a sound level meter will be very useful in measuring noise levels.

Objectives for Noise Pollution Unit

1. Students will label a diagram of the ear and tell how each structure contributes to hearing.

2. Students will write a definition of noise.

3. Students will explain at least three ways noise affects the human body.

4. Students will explain why noise can cause human deafness.

5. Students will list at least three ways noise can be reduced in their environment.

The Ear

Sound waves are received by the ear and transmitted to the brain, where meaning is attached to them.

The outer ear is an apparatus to gather sounds. The auditory canal channels the sound to the middle ear.

The middle ear is separated from the outer ear by a membrane commonly known as the ear drum. Three tiny bones (the tiniest in the body) are connected to the ear drum. They are named the hammer, anvil, and stirrup. The stirrup is then connected to the oval window.

When sounds are gathered in the outer ear and channeled through the auditory canal to the ear drum, they create vibrations which strike the ear drum. The vibration of the ear drum set into motion the tiny bones of the middle ear. This movement causes the stirrup to vibrate the oval window.

The oval window separates the middle from the inner ear.

The inner ear is more than an organ for hearing; it is also the sensory organ for balance (the semi-circular canals).

The hearing part of the inner ear is the cochlea, which resembles a snail shell in appearance.

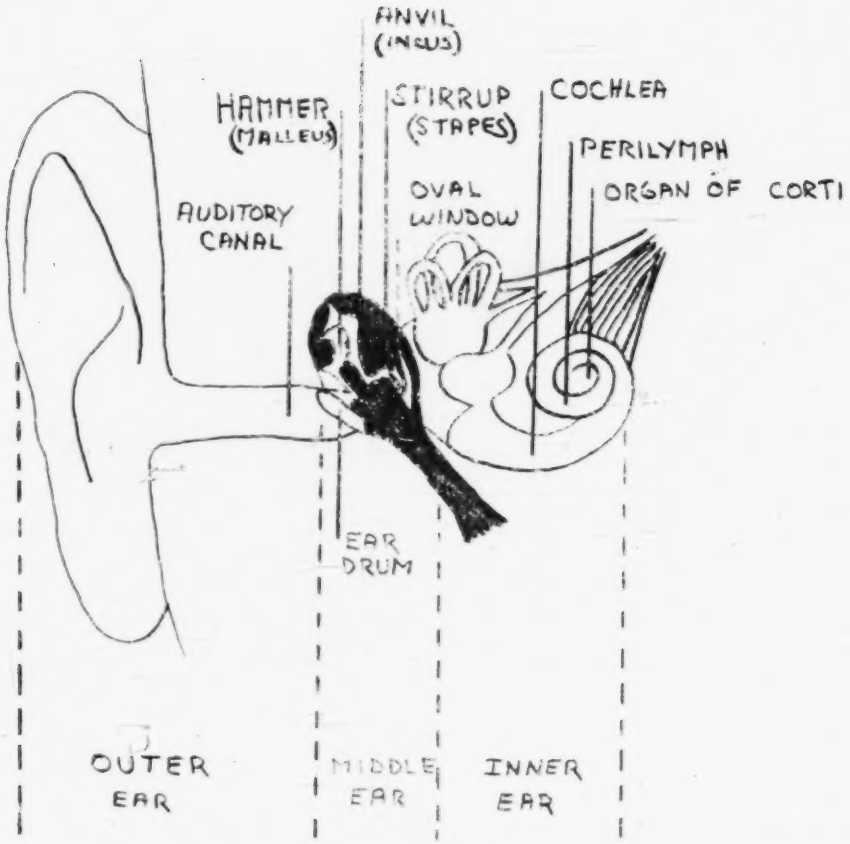
The cochlea is filled with fluid, hair cells, and nerves.

The oval window vibrates setting the fluid into motion.

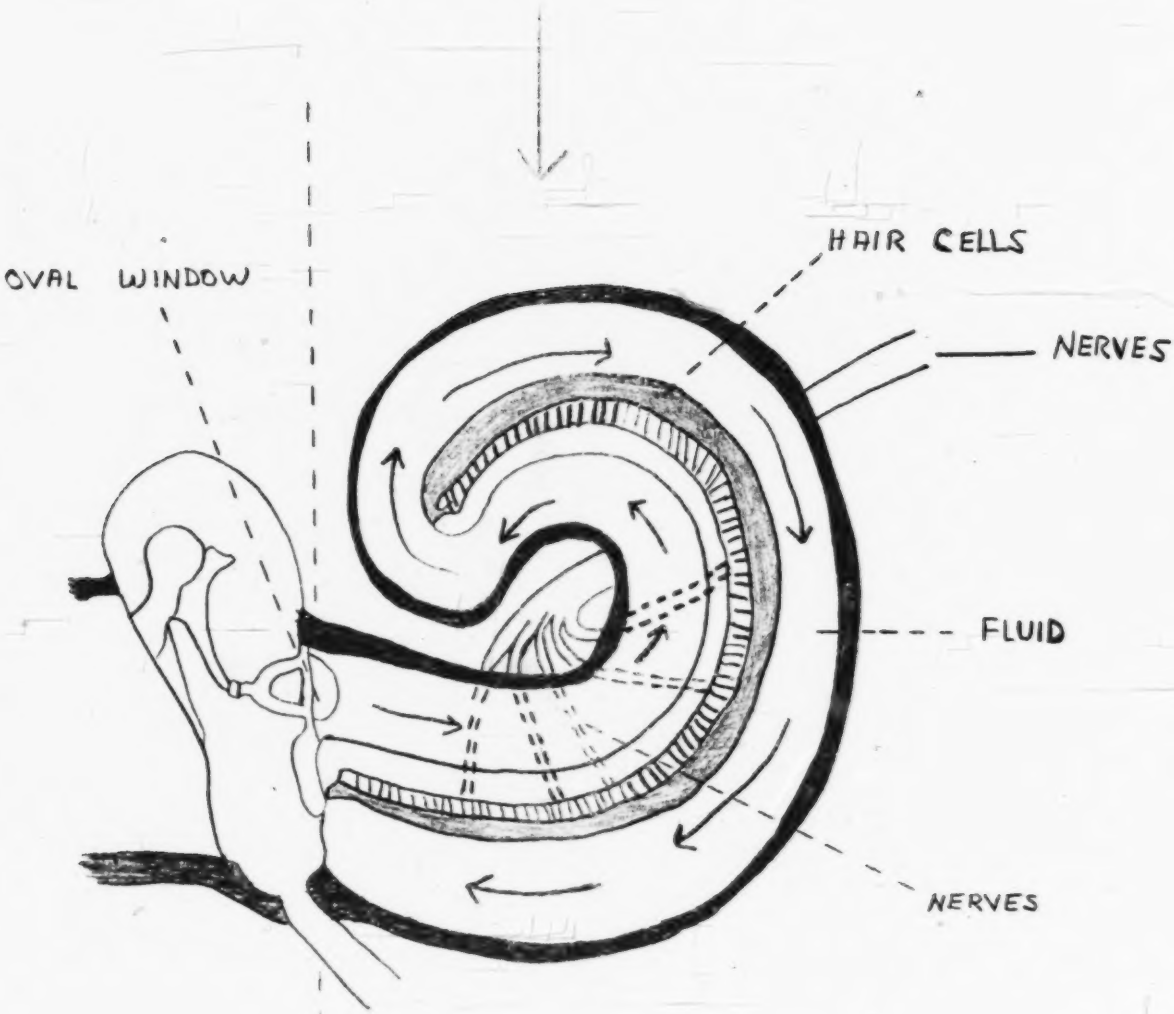
The motion then strikes the hair cells, which send nerve impulses to the brain via nerves in the inner ear.

The brain interprets these impulses into sounds of meaning.

THE EAR


ANVIL
(INCUS)
HAMMER
(MALLEUS)
STIRRUP
(STAPES)
COCHLEA
PERILYMPH
ORGAN OF CORTI
OVAL
WINDOW
AUDITORY
CANAL
EAR
DRUM
OUTER
EAR
MIDDLE
EAR
INNER
EAR

THE INNER EAR



THE COCHLEA

NOISE POLLUTION

Pollution -- Examining Your Environment, Wentworth, Couchman, MacBean, Stecher

Noise can be defined as unwanted sound. -- p. 78

Noise pollution occurs when people are subjected to an excessive amount of unpleasant sounds. -- p. 78

Over 6,000,000 industrial workers now on the job in the United States will be partially or totally deafened by factory noise. -- p. 78

When you are breathing normally, the sound you are making is about 10 decibels. -- p. 78

The most serious noise makers are aircraft, railroads, and traffic. -- p. 78

The overall loudness of noise outside our homes is doubling every 10 years. -- p. 78

Far more difficult to measure than the effect of noise on our hearing is the ways that it bothers us mentally. It can cause a person to feel anxious, nervous, and irritable. The same sound affects everyone differently. -- p. 78

The Shrinking Outdoors, Gary Jennings

There is the ever-present noise of too many people living too close together. So many of us have grown up with this "ear pollution" going on that we may not realize how it is doing us damage, both physical and mental. -- p. 160

Sound intensity is measured in decibels, one decibel (1 dB) being about the sound of a pin dropping. -- p. 160

An ordinary household operates at about a comfortable 40 dB average. --p. 160

A four-piece rock combo equipped with amplifiers blasts out as much as 120 dB. -- p. 161

A noise of 90 dB is the loudest a person can listen to for any length of time, without suffering damage either to his hearing or to his agonized nervous system. -- p. 161

Roar of traffic	90 dB	
Yowl of baby	92 dB	
Power lawnmower	96 dB	
Unmuffled motorbike	100 dB	
Jet plane	102 dB	
Snowmobile	108 dB	-- p. 161

16,000,000 people in U. S. already suffer impaired hearing caused by the noise around them. -- p. 161

Even unborn babies can hear these noises, and some scientists believe that their future mental stability is thereby threatened. -- p. 161

Man and His Environment, grades 5 thru 8 -- transparency and work sheet.

Ecology and the Study of Pollution, grades 4 to 8 -- transparency and work sheet.

Noise -- The Unseen Enemy, M. Barbara Scheibel

We cannot make the world uninhabitable for other forms of life and have it habitable for ourselves. -- p. 9

The earth is becoming uninhabitable for other forms of life. Thus, man's future existence is in question. -- p. 9

Modern, civilized man has the idea that he is something apart and different from other living things. He does not consider himself to be an animal or creature as the other forms of life. Modern man thinks and acts as if he has the right to exploit the use of nature. -- p. 10

Hearing provides us with a different conception of our world, an identification process through an intangible phenomenon, sound. It is intangible because sound has no sustained physical properties. Of the five senses, sound is the least limited by the transmission media. You can hear and identify sounds emanating from sources you cannot touch, taste, smell, or even see. -- p. 15

You have little control over what you hear. -- p. 15

Unwanted sound has consistently grown worse until it has been labeled noise pollution by twentieth century environmentalists. -- p. 15

Sound is an outcome of motion and motion never ceases. -- p. 17

Sound occurs as a three part phenomenon -- source, transmission, and effect. -- p. 17

The source sets the sound waves in motion which cause a transmission of energy, taking the form of vibrations. -- p. 17

Sound can cease to be heard and actually cause pain. The threshold of pain is approximately 140 decibels. -- p. 23

The amplitude (loudness) of a sound has no effect upon the speed of its travel. The roar of a rocket engine travels no faster than a whisper. -- p. 25

Sound waves exist above and below the frequency range of the human ear. The lows are infrasound; the highs, ultrasound. Researchers thus far have been unable to determine whether there are any serious, adverse physiological or psychological effects caused by sounds outside our hearing range. We do know that they can cause headaches and irritability. Some sounds in the infrasound range can alter the natural rhythm of brain waves. -- p. 25

Unlike the eye, the ear has no lid. Loud noises instinctively mean danger to any organism with a hearing mechanism. -- p. 32

The most severe damage to hearing occurs in the inner ear. It is the most severe because it is irreparable. -- p. 32

The perception of sound through hearing as well as the physiological reactions to what was heard determine whether a sound is noise. -- p. 38

Noise was not born in the twentieth century. Cabinetmaking and blacksmithing were outlawed more than 2500 years ago in the residential areas of the Greek city, Sybasces. In Rome, Julius Caesar banned nighttime chariot racing because of the racket made by the horses' hooves clattering over the cobblestones. -- p. 38

The population growth is the greatest contribution to noise pollution. -- p. 38

The creation of tools developed new and louder sounds on earth. And as man's tools developed into more sophisticated equipment, the levels of noise developed with them. The Industrial Revolution was a revolution in sound as well. With it came the machine, the greatest generator of noise. It has caused the loudest, most frequent and continuing calamity on earth. And since the Industrial Revolution, increased productivity to meet the demands of a soaring population has steadily increased the volume of noise. -- p. 38-39

Noise level of the home is doubling every ten years. -- p. 39

In our modern age, noise can no longer be considered a nuisance. It causes physiological damage to the ear, auditory nerve, and brain and has been proven to cause deafness, affect heart disease,

ulcers, and hypertension. Hearing loss is now regarded by public health experts as America's leading non-fatal problem. -- p. 41

One in 10 (20,000,000) Americans have a partial or total hearing loss. -- p. 41

One in four Americans is exposed to noise that can cause hearing damage. -- p. 41

More than half of the working millions are exposed to daily noise that can cause hearing damage physiological as well as psychological. -- p. 41

The womb is penetrated by noise. Research has concluded that the fetus (unborn baby) actually hears and reacts to sounds outside its mother's body. When exposed to loud noises, the unborn baby kicks it mother and its heartbeat accelerates. -- p. 43

Noise has two opposing characteristics; it can be both harmful and useful. -- p. 43

Small animals exposed to 160 decibels have been killed. -- p. 44

Noise is suggestive of power. -- p. 44

The Federal Council for Science and Technology reports, "The overall loudness of environmental noise is doubling every ten years." Why?

(1) We are continually mechanizing and machines make noise.

(2) Convenience and speed.

(3) Noise for pleasure. -- p. 44

To curb the deafening decibel level in our modern world, we must begin to change our attitudes. -- p. 46

Effects:
A Canadian military pilot accidently flew an F-104 jet supersonically at an altitude of 500 feet above the Ottawa airport. The roof of the newly constructed terminal building was ripped open, windows and lights were smashed, aluminum flashing was tossed hundreds of yards from the building, and exterior stucco tumbled to the ground. The damage to the tower and terminal building was estimated at $300,000. -- p. 47

A farmhouse in Brittany was devastated, and three people were killed when the boom from a jet shook loose the supporting timbers of the house. Eight tons of barley stored in the loft fell on the occupants. -- p. 47-49

The SST-super-transport plane was defeated by Congress based on noise pollution and the devastating effects of the sonic boom. -- p. 49

Effect determines whether a sound is noise. -- p. 55

Any sound that is physiologically or psychologically initating or damaging is noise. You may be surprised to learn that noise not only can damage the hearing mechanism, it can cause illness and even kill. -- p. 55

Hearing loss can stem from two causes: sociocusis, loss caused by prolonged exposure to noisy environment; presbycusis, age-induced hearing loss. -- p. 55

Noises that cause the greatest threat to hearing are loud, high pitched, purest in tone, and long lasting. -- p. 56

Tinnitus is ringing in the ears. -- p. 56

When our hearing is in danger of being destroyed, our warning signal is physical discomfort. -- p. 56

Dr. Gerd Jansen discovered that a network of nerve fibers and glands that regulate heartbeat, temperature, digestion, and respiration begin to react to noise pressure when it reaches 70 decibels. -- p. 56

That's equivalent to the sound of traffic on a relatively quiet street. -- p. 56

Effects of increasing sounds are dilation of the pupils, dryness of the mouth, and tongue, loss of skin color, and rises in blood pressure and the level of cholesterol in the bloodstream. -- p. 57

Scientific studies have concluded that uninterrupted sleep is a necessary restorative function of the human body. -- p. 57

Researchers have discovered that there are varying stages to sleep from shallow levels to deep levels. -- p. 57

Sleep that is disturbed in any of its stages does not necessarily awaken a person, but the disturbance can raise the level of sleep to a shallower stage. Because the ear cannot block sound from entering the auditory canal as the eye can shut out light, noise calibrated as low as 55 dB can affect a sleeping person without awaking him. The nervous system of the sleeper will respond with equal intensity to sound as if he were awake. -- p. 57

The flow of blood is slowed by loud sounds. Lack of oxygen and nutrients can cause destruction of hearing cells as well as cells of other organs. -- p. 57

Sudden noise has been known to cause heart attacks. Loud sounds evoke fear because they are often connected with danger. Adrenalin is injected into the bloodstream and may cause the blood pressure to rise. -- p. 58

The power to control noise is a major factor in coping with it. --p.58

New York is rated as one of the noisiest cities in the world. -- p. 61

Memphis is known as America's quietest city. -- p. 63

Population Resources Environment, Ehrlich

Noise pollution is more readily solvable with technology, imagination, and determination than most pollution problems. -- p. 177

Environmental Thrust Handbook, U.S. Department of Agriculture

Increasing noise has been found to affect a number of human functions. It may result in more errors in performance and slow down in intellectual work. -- p. ET-13

An earth bank or mound is generally judged to be the most effective form of noise barrier. -- p. ET-15-71

Where space is limited it is likely that a solid wood fence, combined with plantings, would do much to reduce highway noise at considerably less cost than that of a masonry wall. -- p. ET-15-71

An Introduction To Pollution, Mary S. and Harold E. Schlichting

Elementary Book

The Fight For Quiet, Theodore Berland

Sound is to air what waves are to water. The analogy is more than rhetorical: sound waves do indeed break upon the eardrum as the waves of the ocean break upon the shore. -- p. 3

There is no sound in a vacuum; a vacuum, by definition, is nothing, and sound requires something to carry it. -- p. 3

Sound travels through air by squeezing unseen molecules of air together in very orderly ways. -- p. 4

The waves in the air are sound and hence are called sound waves. -- p. 4

Because of the physical nature of air, they travel at about 1,100 feet per second or 344 meters per second or about 760 miles per hour. -- p. 4

Frequencies above 20,000 cycles per second are called ultrasonic. -- p. 5

Below 15 cycles per second is called infrasonic range. -- p. 5

The three bones of the middle ear are the tiniest bones in the body. -- p. 13

Many noise levels encountered in the community exceed standards found injurious in industry. Hearing loss, formerly thought to be a hazard of aviators and boiler-makers, occurs with age (presbycusis) after lifetime exposure to noise at community level. -- p. 11

Between 6 million and 16 million workers in the United States earn their livings under conditions that are hazardous to their health. -- p. 28

American adults with more education and higher incomes (reflecting the quieter, professional occupations) had better hearing than those with less education and lower incomes. -- p. 29

In all of industry the world over, the weaving sections of the textile plants is one of the noisiest and most destructive of hearing. -- p. 30

Noise has been defined as any sound that is regarded or treated as a nuisance. The degree of annoyance is not necessarily related to the intensity of sound. . . The noise of racing cars may be pleasant to their drivers but maddening to those living near the track. . . Attitude of mind and environment are of major importance. -- p. 46

Noise creates violence, murder . . . etc. -- p. 48-49

Animals react less aggressively to noise than man does. Cows abort and hens refuse to lay eggs, all because of fright. -- p. 49

These are very specific ways by which noise grates on our nerves and affects our emotions and behavior. Essentially these are: interference with our communication, interrruption of our sleep, and inspiration of fear. -- p. 61

Noise affects your body before birth. The inner sea of fluid in which the unborn floats protects as it cushions him from major physical trauma such as light and shock. But from noise it protects little, as it transmits sounds from within and without -- the incessant pounding of his mother's heart, the swishing of air into her lungs, the very sound of her voice. -- p. 83

The hearing mechanism has reached normal development about the sixth month after conception. In the seventh month of pregnancy, the fetus's body responds to noise by changes in his little heart's fast rate of beat. -- p. 84

Noise, at even low levels, causes the tiny peripheral blood vessels, in the fingers, toes, abdominal organs, and skin to constrict, cutting down the supply of blood there. -- p. 95

Noise can kill. The hooting of a car symbolizes that mortal danger. The noise made by a motor horn two yards away is estimated at 85-100 phons. It has been established that man's visual reaction drops by 25% when the noise level rises to 90 phons. -- p. 104

A group of soldiers were submitted to a loud noise for 15 minutes. They were then tested and it was discovered they were color blind for over an hour. -- p. 105

Noise affects eye sight. -- p. 106

Besides the toll which noise imposes on our bodies, our emotions, and our hearing, there is the physical mayhem and destruction it wreaks. For noise not only shocks us, maddens us, distresses us, and deafens us, it physically wrecks our surroundings as well. -- p. 119

The number of private cars alone rose from 4 million in 1960 to 10 million in 1966, and it's expected to reach about 20 million by 1980. -- p. 138

Noise pollution has crept up on us. Ten years ago someone said it was climbing at the rate of one decibel a year. That's still true. -- p. 140

Noise is with us from the moment we arise in the morning, following us around our homes to our work, bombarding us as we work, as we play, and even as we sleep, or try to. It has become a new form of trespass, a new invasion of privacy. Before the Industrial Revolution, comparatively few people were exposed to excessive noise. The position changed rapidly with the advent of power-driven machinery. -- p. 148

Air pollution kills us slowly but silently, noise makes each day a torment. -- p. 149

The affective spectrum of music ranges from the deepest gloom to the highest state of exaltation. -- p. 158

In the United States in 1968, 101 million motor vehicles were operated by 105 million licensed drivers. America's 84 million private automobiles account for about 93% of its passenger travel. And the four-wheeled population keeps increasing exponentially. So do the numbers of those raucous two-wheeled ear-splitters and bone-breakers known as motorcycles. -- p. 162

The most obvious and alarming noise from motor vehicles is that caused intentionally by their horns. -- p. 162

The second most disturbing noise is produced at the waste end of the engine: the exhaust. -- p. 164

The noise of vehicular traffic is the most important of our common noises because of its prevalence and its intensity or loudness. Heavy traffic noise often reaches close to 80 dB and exceeds industrial noises. -- p. 162

The total air flight hours for plans in the American and Canadian jets was 2,771,357 hours. -- p. 173

Along with the tremendous increases in the volume and comfort of air travel around the world have come tremendous increases in noise. -- p. 174-5

Few of us can turn noise into such a positive force as did Julia Ward Howe. It is said that she was awakened one night at the beginning of the Civil War by the clatter of Federal troops marching into Washington. Rather than put a pillow over her ear, or even pen a complaint to the District administration, she sat down and wrote "The Battle Hymn of the Republic." -- p. 191

Noise is a torture to intellectual people. Noise is the most impertinent of all forms of interrruption. How many great and splendid thoughts have been lost to the world by the crack of a whip.--p. 191

Two most practical ways to deal with noise: you can withdraw from the noise, or have it withdrawn from you. -- p. 194

The cheapest and easiest way to withdraw from noise is to block it from your ears. -- p. 194

If you want to join the Fight for Quiet, write to your governmental representatives at every level, join an appropriate anti-noise organization, and contribute your energy and money. Only through massive public participation and education can the people win. Only by fighting can we win the struggle for quiet. And we will win, or we will all drown in a rising sea of noise. -- p. 294

Noise Pollution

Activities

1. Environmental Education Picture Packet, Teacher's Manual
   Write or discuss the picture on noise pollution
   Equip.: Environmental Education Picture Packet or 2 pictures contrasting a noisy scene - quiet scene

2. Play a phonograph record at normal volume; then keep increasing the volume. Jot down your reactions.
   Equip.: Record player and record

3. Sounds connected to pictures - show class different pictures and have them produce sounds symbolic to picture.
   Equip.: Pictures; machinery, running water, animals, etc.

4. Close your eyes and listen carefully for a few minutes. Make a list of all the sounds you can hear. Compare list. Why do some hear better than others?

5. Make sounds and let students react.
   Scratch nails on board - demonstrate sounds cause nerves to react.

6. Record sounds around your school, traffic, factories.
   Equip.: Tape recorder.

7. Record sounds around your home.
   Equip.: Tape recorder.

Activities

Can listening to a loud sound for 15 minutes produce a temporary loss of hearing?

Equipment: Watch, radio

Place your ear close to the speaker and listen for 15 minutes. Turn the radio off and try to hear your watch ticking when you hold it up to your ear. Note how much time passes before you can hear the ticking of the watch again. Mark the volume dial of the radio so that the same volume can be used again. Repeat the experiment again the next day but only listen to the radio for 10 minutes. Try it one more time on the third day but only listen for 5 minutes this time. Make a chart to record your observations.

Which length of listening time produced the longest time for which the watch could not be heard?

Predict how long you would not be able to hear the watch if you listened to the loud noise for 20 minutes, 30 minutes, and 1 hour.

What do you think would be the result of listening to the loud noise for a month or more?

How does the distance one is from the source of a sound affect its loudness?

Equipment: Tape recorder

Measure the loudness of a car horn in the parking lot. Ask a friend to peep the horn for you. Measure or record the sound at intervals of 10 paces as you move away from the car. Plot the information you collect.

Where was the sound the loudest?

How did the volume of the sound change as you moved farther from the source?

Why was a car horn used instead of just having someone shout loudly?

How far away would you have to be from the source before the horn could not be heard?

When comparing the volume of two or more sounds, why should the tape recorder be used at the same distance from each sound?

If you can hear a sound when you are a long way from it, what does this tell you about that sound?

How would a strong wind change the results of your experiment?

How does the size of the space in which the sound is contained affect its loudness?

Equipment: Battery, buzzer or bell

With wires attach a buzzer or bell to a 6-volt battery so that the bell or buzzer will produce a steady sound. Use a yardstick to help you locate a tape recorder 3 feet from the source of sound.

Record the loudness of the sound when the source and tape recorder are placed in as many of the following locations as you can:

(a) in a closet with the door closed,
(b) inside a room when it is vacant,
(c) inside the same room when it is crowded with people who are very silent,
(d) in a vacant hallway,
(e) in a gymnasium or auditorium,
(f) in a vacant schoolyard when it is quiet,
(g) in the center of a large field.

Record your observations in a chart.

In which location was the sound the loudest? In which location was it the softest?

In which location was there the greatest and least space?

Why was the yardstick used in this experiment?

In which locations might echoes make the sound appear louder?

In which locations would materials such as carpets, curtains, cement, wood, smooth or rough surfaces help in making the sound softer?

Where in your community would sounds seem louder because of the size of the space in which they are confined?

How loud are some sounds?

Use your tape recorder to measure the sound coming from as many of the following as you can. Try to hold the microphone of the tape recorder the same distance from each object. Keep a record of what the sound is that you are measuring and anything such as echoes or winds that might make the sound appear louder than it really is.

Which sounds were the loudest?

Which sounds were louder than a power lawnmower?

Which sounds appeared louder or softer because of the space in which they were contained?

Which sounds appeared to be made louder or softer for other reasons?

Which sounds would be harmful to human ears?

Which sounds predominated, that is, could be heard above the other sounds?

Where does noise pollution occur in your community?

Record the sound of a gasoline powered lawnmower at a distance of 3 feet with your tape recorder. Sounds which are as loud or louder than this sound can damage our hearing. Record sounds in as many of the following locations as you can:

(a) busy street corners in your neighborhood,
(b) busy streets downtown,
(c) in a railway station when trains come and go,
(d) in an arena or an auditorium during a sports event,
(e) a factory with heavy machinery, (ask permission to visit this area
(f) near a piece of heavy construction equipment if the foreman says it is all right,
(g) on the schoolyard at recess time,
(h) in the school boiler room when the furnace and other machinery is in operation.

List the sounds that are louder than the sound made by the gasoline powered mower.

Where were sounds that were louder than the power mower found?

In which areas did sound pollution occur?

What techniques, similar to those used in other activities, should be followed when testing these areas for noise?

What other places could be investigated for sound pollution?

In which other ways might sound pollution affect people other than hurting their ears?

How does noise pollution affect wildlife?

If you live near a jet airport or near a factory which continually produces loud noises, examine the area around it for signs of wildlife living in that neighborhood. Look for birds and squirrel nests, groundhog and rabbit holes and any other animal homes you can find.

Next, visit a similar area which does not contain a loud source of noise. Compare the number of bird and animal homes in the two areas. Which area had more animal homes?

How far from the source of noise did you travel before you found bird or animal homes that were in use?

What other things, besides noise, might account for any differences you observed?

What other signs can you find that animal life was avoiding the loud noise region?

A
B
C
I
H
I
J
O
P
Q
V
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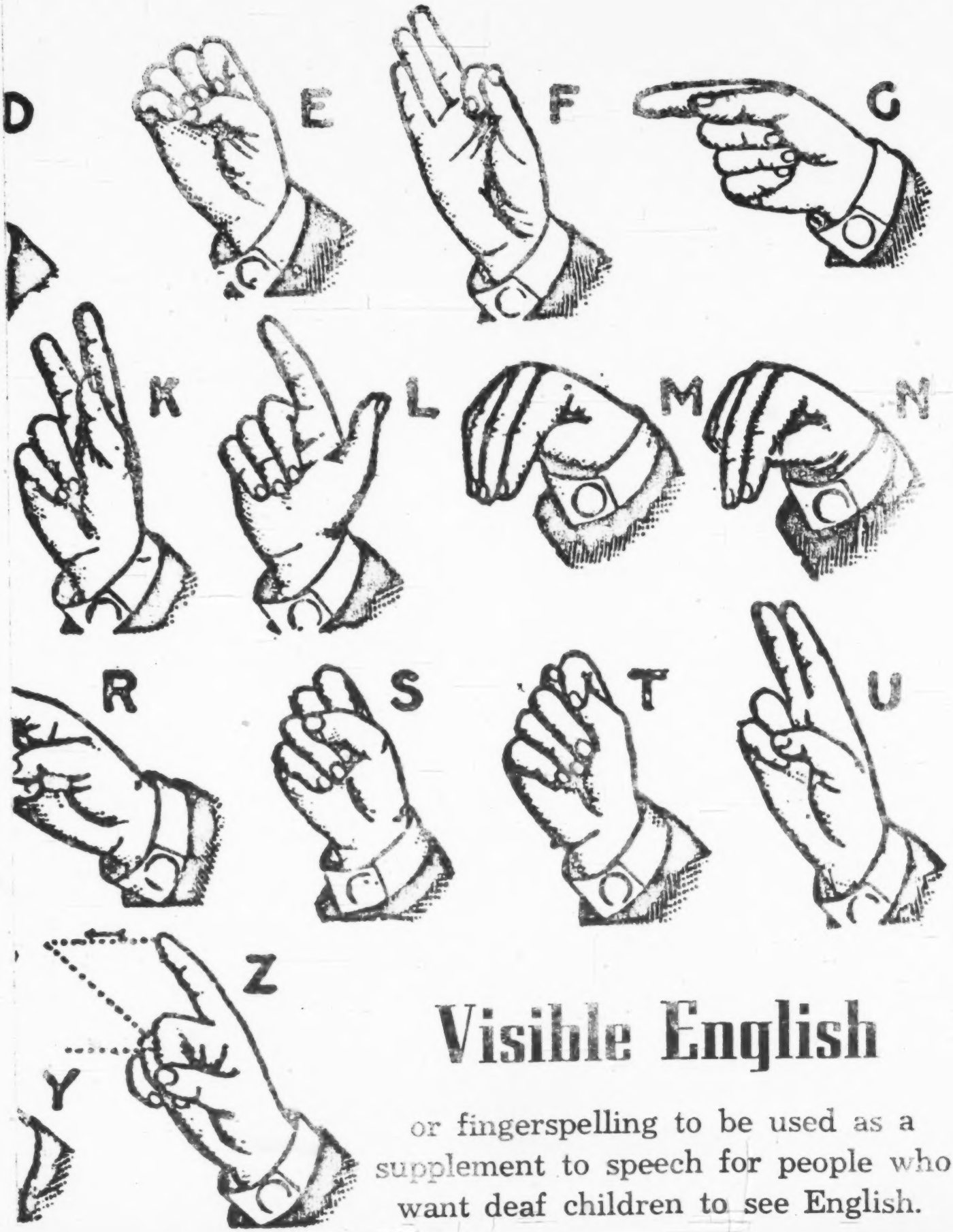

Visible English

or fingerspelling to be used as a supplement to speech for people who want deaf children to see English.

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EDUCATIONAL EXPERIENCES PROGRAM

SOLID WASTE

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Burke County Title III
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Objectives for Solid Waste Unit

1. Students will list the six basic categories of solid waste.

2. Students will list at least one major source of each of the six basic categories of solid waste.

3. Students will identify at least three ways solid waste affects human health.

4. Students will name at least two ways for correctly disposing of solid waste.

5. Students will list two advantages and two disadvantages of recycling solid waste.

6. Students will explain the main system of solid waste disposal in Burke County.

SOLID WASTE

Solid waste is composed, basically, of solid materials that people no longer want. Litter, junked cars, broken appliances, scraps of materials from factories, empty food containers, broken toys, broken furniture, food scraps, and torn down buildings are a few examples of solid waste.

Solid waste can be separated into six different categories. Let's take a look at these six categories and learn some of the problems they cause.

1. Glass -- Made primarily of melted sand, glass containers present several waste problems in Burke County.

   a. It takes energy (from burning coal or oil) to produce glass. Most glass containers are used once and thrown away. More energy is used to make new ones.

   b. They are an eyesore when discarded.

   c. They present a danger, when broken, to people swimming or walking and to machinery such as mowers and tires.

   d. The manufacture of glass produces chemical by-products which glass manufacturers dump into the air, lakes, and streams.

   e. They do not break down quickly and will remain when thrown away for thousands of years.

Glass is recyclable. This means that the glass can be used over again and again. To recycle glass it is shipped to the manufacturer, ground up, washed, and melted. It is then poured or injected into a mold, allowed to cool, and presto, a new bottle or whatever.

Glass is not recycled in Burke County. Why?

   a. Because when a glass manufacturer sells more pounds of glass he makes more money and gets richer. When you use a soft drink bottle once and throw it away the glass manufacturer is asked by the soft drink company to make another bottle. The glass manufacturer wants you to use more glass and discourages the use of bottles you can use over and over. If you drink ten soft drinks in non-returnable bottles the manufacturer sells ten bottles. If you drink ten soft drinks in returnable bottles, and return the bottle after drinking each time, the manufacturer only sells one bottle. In Burke County the manufacturer has eliminated the alternative of buying beer in returnable bottles. In this way

the glass manufacturer has assured himself of selling more glass. Who pays for this? You do in three ways. First, you buy the bottle instead of "renting it." Second, you pay in terms of a deteriorated environment. Third, you pay to haul the bottle to the dump when you are finished.

b. There is no system set up to get glass back to the manufacturer. The citizens and governmental officials in Burke County don't want to pay the price to solve the glass problem so they cover it up or ignore it (or talk about it). They won't pass laws to eliminate non-returnable glass containers. Why?

c. Glass manufacturers make it difficult and costly to establish a system of recycling. The nearest glass plant that will buy glass is in Asheville. It is the Ball Glass Company. They will not buy glass that is broken. The labels must be removed from the glass. Any metal caps, etc., must be removed from the glass. The glass must be separated into piles the same color, such as clear, green, and amber. The glass must be clean. You must transport the glass to Asheville and this is very expensive.

d. Can you think of any other reason glass is not recycled in Burke County?

2. Paper and Wood

Although Burke County is a world center for furniture manufacturing, wood scraps are not a serious problem. They are organic (come from living substance) and decompose harmlessly when landfilled, thus recycling themselves. Much of the scraps could be chipped and used to make paper. Paper, however, is a definite problem. Paper pollutes several ways.

a. In order to make paper you must cut down forests or make it from other paper. Wasting paper is wasting trees. Most paper today is made from trees.

b. Paper is an eyesore when discarded.

c. Paper mills use chemicals to process the wood pulp. Paper mills are a major contributor to mercury pollution in streams. Most paper mills, such as the one at Canton, N. C., are also a major contributor to air pollution.

Paper, like glass, can be recycled. Newspapers, notebook paper, IBM cards, bags, and cardboard boxes can all be recycled. The paper must be "de-inked" before the fibers can be used. Paper that is coated with wax, such as cups and cartons, can not be recycled. Many trees could be saved if we returned to milk being put in deposit bottles.

You may say that toilet paper can't be recycled at a mill after it is used. You are right! But if we were as conservative with paper in general as we are with toilet paper, much of our forests could return. One of the more serious examples of paper being wasted is in packaging. Look around the grocery store, or any other store, and see how much paper is used to glamourize the object being sold. It serves no purpose other than to get you to buy something you probably didn't need in the first place. For each ton of paper made, 17 trees must be cut. Each Sunday edition of the N.Y. Times requires 80,000 trees.

How many businesses in Burke County recycle their cardboard and waste paper? What do they do with it? Why?

Is there a place locally to recycle paper?

Is there any paper or cardboard manufacturing in Burke County?

3. Metal

Metal waste primarily includes iron, steel, aluminum, lead. copper, chromium, nickel, gold, mercury, zinc, and tin.

Metal wastes are commonly found in the form of junk cars, radios, T.V.s, industrial scraps, electronic parts, and cans, especially cans.

Metal waste pollutes by:

a. Vast amounts of energy is required to produce metals in pure form and machine it. Aluminum cans, for instance, require much more energy to produce than steel ("tin") cans.

b. In order to get many metals the earth is bulldozed and torn apart making it useless and incapable of supporting life.

c. Metal ores are processed in huge furnaces at high temperatures. This heat releases very poisonous substances such as cadmium into the air and into streams. Many steel mills dump acid waste into streams. Life in Lake Erie was destroyed by steel mills. Which is the most serious, the litter caused by a steel can or the waste produced by a mill to make the can?

d. Cans along the road are an eyesore. Aluminum cans may take thousands of years to "rust" away like steel cans. The aluminum could be used to produce a lasting, valuable product such as homes.

Metal can be recycled in much the same way that glass can. Nationwide, recycling now supplies 1/3 of all the aluminum made, 1/2 the copper and brass, and 1/2 the lead. The reasons that glass is not

recycled in Burke County are also true for metals, especially steel cans. Steel brings about $20 per ton as scrap which is about 10,000 average size soup cans. In contrast aluminum brings about $200 per ton.

4. Food Waste

Food waste is organic and breaks down in the soil quickly. It only poses a problem in that it produces food for disease carrying flies and rats. Many people in Burke County have gardens and can make them richer by composting and returning the unused food to the soil for fertilizer.

5. Plastics

Plastics pose a serious solid waste problem in Burke County. There are thousands of types on the market today. Most are made from oil or petroleum products with different kinds of chemicals added to give them certain properties. Most are polymers. This means that oil molecules were taken apart and rearranged to form a long chain molecule that has properties very different from oil. The most common plastics that cause a waste problem are polyvinyl-chloride (abbr. PVC) and styrofoam.

PVC is a polymer. It is also a chlorinated hydrocarbon. This means that chlorine, an element, is added to the oil which is made of atoms of hydrogen and carbon. This chlorine, hydrogen, and carbon are combined chemically in the form of a chain. There are other kinds of chlorinated hydrocarbons. Examples are tear gas and the smell of a skunk. PVC is used to make plastic milk jugs, car floor mats, car seat and dash covers, plastic food bags, laundry baskets, shampoo bottles, plumbing pipes, etc. PVC is a hard, stiff plastic. To make it more flexible it is injected with different kinds of chemicals called plasticizers. These molecules are not attached to the PVC molecules. Instead they fill the spaces between the PVC molecules, and, therefore, can evaporate. This causes the PVC to become brittle. A plastic milk jug, which is stiff only has a small amount of plasticizer in it. A plastic food bag, on the other hand, has a lot of plasticizer. The odor inside a new car is primarily plasticizers that have evaporated from the vinyl upholestry. This occurs more quickly if the car is left in the hot sun with the windows rolled up. The plasticizer leaves a dingy film on the windows that must be cleaned periodically. Is it harmful to breathe plasticizers? In Viet Nam it was noted that some men who were given massive blood transfusions suddenly died with a condition that was named "shock lung." Doctors discovered that plasticizers dissolved from the PVC bag in which the blood was stored, into the blood, and, in massive transfusions accumulated enough to cause death.

Some plastics such as styrene, can be recycled. Most, including PVC cannot. In general, plastics pollute by:

a. Using up valuable petroleum to make products that are only used once and thrown away.

b. Burning plastics (a common method of disposal) creates air pollution. When PVC is burned the chlorine in the molecule joins with the hydrogen forming hydrochloric acid. This rains out of the air and corrodes metal, dissolves nylons, and destroys cement. You can imagine what it does to skin, eyes, and lungs.

c. Plastics create an eyesore. PVC is a very stable compound and will remain in the soil for years. The half life of PVC is 85 years. Since they are not recyclable they are automatically a "one-way" container.

d. They create, like most "one-way" products, a psyche geared to consume more and more.

e. The manufacture of plastics creates tremendous amounts of industrial waste chemicals. These are dumped into air, stream, lake, or ocean by plastic manufacturers.

6. Mineral materials

These include brick, stone, old concrete, dirt, and gravel. They are, basically, natural materials and their harm is negligible. They are very good landfill materials but become an eyesore if dumped or piled anywhere.

In the U. S., 90% of our garbage is either burned or buried. The burning is done either in open dumps or by mixing the garbage with coal or gas.

Activities to Investigate Solid Waste

Glass

1. Have a student or group of students find out the history of glass.

2. List the qualities of glass that make it a good container. List its drawbacks.

3. Have students bring in various bottles. What color are they? How is the color produced? Why are they colored? Does the bottle have a cap? What is it made of? Does it have a label? What is the label made of? How is it glued on? Will water soak it and the glue off? Buy or borrow a Bottle and Jug Cutter. Make various things with the glass (follow directions and be careful of glass in eyes). Will making crafts from nonreturnable bottles solve the problem created by them? Why?

4. Look in a science book and find out how to make glass. Have the class try to make a small amount of glass.

5. Investigate the properties of glass (refer to science textbooks).

6. Who are the major glass manufacturers in the U.S.? Where are they located?

7. What is pyrex? What is ceramic? What is corelle? What is china? What is crystal? What is flint glass? Get some pyrex glass tubes from a science lab. Look in a chemistry lab book and have students learn how to cut it, bend it, melt it. What happens to hot glass when it gets water on it? Can you tell if glass is hot by looking at it? Have the students make a glass jet or an eyedropper. Have them make a "crazy straw" by bending a long glass tube at all kinds of crazy angles.

8. Have the students etch their name or a design on a bottle, glass, or window pane. Here's how:

   a. Obtain some hydrofluoric acid (HF) from a high school chemistry lab or order it from a chemical supply house.

      Hydrofluoric is a very dangerous chemical. It should only be used under constant teacher supervision. Contact with skin does not cause pain until later and causes a burn which is very slow in healing. If a student gets HF on his skin it must be flushed with

cool water for 3-4 hours. A doctor should also be called immediately. Students should wear goggles, glasses, or sunglasses at all times when working with HF. Do not tolerate breaking the safety rules! Work outside with HF on a calm day and have students stay upwind of any fumes produced. Do not allow curious students from other classes to be in the vicinity. HF reacts with the silicon in glass and dissolves it. Thus it must be shipped in wax or plastic bottles. It does not react with wax and certain kinds of plastic. The reaction is: Hydrofluoric Acid and Silicon Fluoride and Water. If a students gets HF on his eyeglasses it will etch them!

b. Coat an area of a bottle with wax or paraffin.

A thin coating works best. To get a thin coating, first spread on a fairly thick coat and then heat the bottle gently until the wax melts.

c.

Using a toothpick, sharp pencil, or other sharp device, draw the desired design into the wax. Make sure you get all the wax off the places you want the acid to dissolve.

d. Apply a few drops of acid (wear goggles!) to the design area spreading it with a stick until the design is covered. Do not use too much acid. It only takes a few drops. Mark one end of the stick as "handle" so students will not touch the acid end. Caution them about this! Set the glass aside in a safe place for 5 or 10 minutes.

e. Wash the acid off onto the ground with clean tap water. Rinse it well.

f. Scrape the wax off with a popsicle stick or other device. Rub hard with paper towels to get the last bit of wax off until the bottle is clean and shiny. Presto, the design is etched into the glass!

g. Do it again but get creative in your designs.

h.

wine or beer bottle

+

glass cutter =

drinking glass

sand down sharp edge with emory paper

drinking glass +

Hydrofluoric acid and wax =

personalized drinking glass

i. The reaction that occurs is:

HYDROFLUORIC ACID + SILICON -- SILICON FLUORIDE + WATER

Paper

1. Have a student or group of students find out and report on the history of paper and papermaking.

2. Make a list and collect examples of as many paper products as possible. Which of these items become waste after being used once. Which are commonly used several times? Which are used many times? Which are only used to promote or advertise a product? Which are alternate materials that could be used?

3. When you waste paper, you waste trees. How many examples of wasting paper can you find in the classroom?

4. What are the raw materials used by a paper mill? What are the pollutants produced?

5. Try to establish a notebook paper recycling system at school.